ARCHIVES OF SURGERY

VOLUME 57 DECEMBER 1948 NUMBER 6

COPYRIGHT, 1949, BY THE AMERICAN MEDICAL ASSOCIATION

CARCINOMA OF THE PANCREAS

HOWARD K. GRAY, M.D.
ROCHESTER, MINN.

IN THE preface to his exhaustive work on the "Surgery of Pancreatic Tumors," Brunschwig [1] stated that from the surgeon's standpoint the pancreas has been regarded as the "hermit organ" because of the rarity with which operations have been performed on it and because surgeons have been reluctant to undertake such procedures, often fearing the development of acute pancreatitis as a complication of the operation itself. This dismal situation has changed rapidly, however, in the last fifteen years, owing to the abundant information that has accumulated relating to diagnosis, preoperative and postoperative care and surgical technic. Not the least factor has been a willingness on the part of many surgeons to challenge and to conquer this natural aversion to direct surgical attack on the pancreas and, by so doing, to demonstrate that partial, and even total, pancreatectomy can be done without imposing undue risk.

That a relative increase should be noted in the direct attack on malignant lesions as compared with benign lesions is not surprising, since undoubtedly it is the result of a residual disinclination on the part of the surgeon to impose the risk attending the radical procedures in cases of benign lesions and of the fact that malignant lesions of the pancreas that are amenable to surgical treatment actually occur in greater numbers than do benign lesions.

PATHOLOGIC CONSIDERATIONS

Ewing [2] stated that two main types of pancreatic carcinoma are observed: (1) cylindric cell carcinoma, arising from the ducts, and (2) carcinoma simplex, arising from the parenchyma. He reviewed the literature, and from his own extensive experience we have obtained a description of these neoplasms, from which the following quotation is taken:

From the Division of Surgery, Mayo Clinic.

Part of a symposium on cancer read at the centennial celebration of the University of Buffalo, Buffalo, N. Y., Oct. 2, 1946.

1. Brunschwig, A.: The Surgery of Pancreatic Tumors, St. Louis, C. V. Mosby Company, 1942.

2. Ewing, J.: Neoplastic Diseases: A Treatise on Tumors, ed. 4, Philadelphia, W. B. Saunders Company, 1940, pp. 764-765.

(1) Carcinoma of the ducts [cylindrical cell carcinoma] may be associated with proliferation of lining cells in the outlying regions, which Hulst observed in a case of periductal fibrosis and interpreted as precancerous. Ollivier also traced his case of cylindrical-cell tumor from such preliminary changes. Munkenbeck, however, found reason to believe that cylindrical-cell tumors might develop from the parenchyma.

The tumors are regularly located in the head or corpus, and form somewhat massive growths which are imperfectly separated from the parenchyma. They are firm from fibrosis or contain many small cysts, or the central mass is broken down, suggesting an origin from cystadenomas.

The structure is composed of papillary outgrowths and alveoli lined by cylindrical or cuboidal cells. In atypical areas the cells may lose their cylindrical form and grow more diffusely. Yet Hulst found the cylindrical type preserved in secondary tumors of lymph-nodes and liver, and Satti reports a cystadenoma papilliferum with typical metastases in lymph-nodes, lungs, and peritoneum.

The local extensions of the tumor have been traced by Ollivier through ducts, lymphatics and nerve-trunks . . . .

(2) Carcinoma of the parenchyma produces a more diffuse, rapidly growing tumor which is firm or soft according to the proportion of fibrous tissue. The cells are small or large, granular, hydropic, or fatty, resembling those of the pancreatic alveoli. The cell borders are often indistinct, and the vesicular nuclei occupy much of the cell. Nucleoli are poorly developed. The relatively large size of the nuclei is often a notable feature. The cells are arranged in small or large alveoli separated by a fine stroma, and in some cases the appearance suggests a simple cirrhosis in an otherwise unaltered pancreas (Bard, Pic). In the larger alveoli the outer cells may be cubical. In some cases there is a definite lumen in the cell groups, filled with coagulum. These spaces may then be lined by high cuboidal, or low cylindrical cells . . . .

In more atypical and malignant tumors the cells are smaller and embryonal in type, and the arrangement may be irregular and diffuse. Such cases may resemble lymphosarcoma with a faint alveolar tendency.

CARCINOMA OF THE ISLANDS OF THE PANCREAS

Wilder, Allan, Power and Robertson [3] evidently were the first to call attention to a malignant lesion arising from islet cells which had caused severe spontaneous hypoglycemia. The patient in whom this phenomenon had been observed received only slight, if any, benefit from surgical exploration and died a month after operation. Postmortem examination revealed metastasis to the regional lymph nodes and to the liver. Microscopic study of the pancreatic tumor showed the following picture:

In the tail of the pancreas, pancreatic tissue was replaced extensively by focal masses of tumor cells, which were embedded in a dense connective tissue stroma and arranged in irregular strands and islands. These

3. Wilder, R. M.; Allan, F. N.; Power, M. H., and Robertson, H. E.: Carcinoma of the Islands of the Pancreas; Hyperinsulinism and Hypoglycemia, J. A. M. A. **89**:348-355 (July 30) 1927.

cells were somewhat irregular in size, shape and staining reaction, as well as arrangement, but their resemblance to the cells of the islands of Langerhans was striking. The adjacent lymph nodes and the nodules in the liver were composed of similar cells. These, together with other histologic features, as well as the absence of any similarity of this tumor to the usual types of pancreatic and hepatic neoplasms, led to the conclusion that the tumor was a carcinoma arising primarily in the island cells. The condition was brought into prominence by this report, and, although relatively rare, it constitutes a definite clinical and pathologic entity.

Ewing stated that few satisfactory reports of pancreatic sarcoma are available; but on the basis of the available data he expressed the impression that spindle cell sarcoma and lymphosarcoma may arise in the pancreas.

RECOGNITION OF MALIGNANT LESIONS OF THE PANCREAS

It is ironical that carcinoma of the head of the pancreas should become manifest in many instances when the lesion is small enough to permit complete surgical excision and yet be so placed that it may be extremely difficult, if not impossible, to make a positive diagnosis. This refers in particular to small carcinomas of the head of the pancreas that produce extrinsic pressure against the terminal portion of the common bile duct and produce obstructive jaundice. The terminal portion of the common bile duct descends along the posterointernal aspect of the bend joining the first and second parts of the duodenum and then along the inner side of the second part, where it is surrounded more or less by the head of the pancreas. Because of this anatomic arrangement, any attempt to obtain tissue for microscopic examination will entail a rather extensive surgical procedure unless the surgeon is fortunate enough to withdraw sufficient malignant tissue by exploring the common duct from within. It is rare that a specimen of the desired tissue can be obtained for biopsy in this manner in the early stages of obstruction because infiltration of the walls of the common bile duct with cancer will not have occurred and the examining scoop or tissue extractor will encounter only a duct that is compressed from external pressure. It is also ironical that carcinoma of the body or tail of the pancreas (where surgical removal could be accomplished with the least difficulty and risk) should become manifest in many instances when the lesion is so extensive that complete surgical excision is not possible.

Although there is no method whereby the surgeon can accurately recognize the presence of a malignant lesion of the pancreas, much valuable information can be obtained from a carefully taken history and from the results of physical and laboratory examinations.

Bard and Pic [4] are said first to have described the characteristic symptom complex of carcinoma of the head of the pancreas. They called attention particularly to the painless character of the jaundice, the distention of the gallbladder, the cachexia and the loss of weight. A widespread impression has persisted for the past sixty years that this tetrad of Bard and Pic must obtain before a diagnosis of carcinoma of the head of the pancreas can be considered.

Studies have shown that painful features of the disease are numerous and variable. In various series, pain has been reported to be present in from 40 to 85 per cent of cases. Walters and Snell [5] were able to distinguish three types of distress: The first is a dull, lagging, intermittent or continuous epigastric pain, which often is projected to the back and is aggravated by changes in posture; it is likely to be particularly distressing at night and may interfere greatly with sleep. The second is pain which may occur in the right upper abdominal quadrant. This, also, is of a continuous, dull, aching type, sometimes is aggravated by the taking of food and occasionally may reach the proportion of colic. This type of pain was thought to be due to increased intraductile pressure. The third is constituted by severe attacks of distress, which may occur in the middle portion of the abdomen and which are described as "celiac neuralgia." They assume the nature of a cramp or colic.

Combinations of all three types of pain have been observed. The important fact to be emphasized is that pain of some character has been noted by practically all observers in a high percentage of cases, and therefore it cannot be assumed that the occurrence of pain precludes the possibility of carcinoma of the pancreas.

When the lesion involves the head of the pancreas (approximately 75 per cent of cases), jaundice will practically always be present. The nature of this jaundice may give an invaluable lead to the underlying pathologic condition, for it is usually intense and constant. The remissions that are seen so commonly associated with stone in the common bile duct are absent; and, because of the depth of the jaundice (occasionally as much as 60 or 70 mg. of bilirubin may be observed in 100 cc. of serum) pruritus is severe and many factitial lesions may be seen on the skin.

Carter, Greene and Twiss [6] emphasized that to many, Courvoisier's law is the exemplification of all that is definite in the diagnosis of a

4. Bard, L., and Pic, A.: Contribution a l'étude clinique et anatomopathologique du cancer primitif du pancréas, Rev. de méd., Paris **8**:257-282 (April) 1888.

5. Walters, W., and Snell, A. M.: Diseases of the Gallbladder and Bile Ducts, Philadelphia, W. B. Saunders Company, 1940.

6. Carter, R. F.; Greene, C. H., and Twiss, J. R.: Diagnosis and Management of Diseases of the Biliary Tract, Philadelphia, Lea & Febiger, 1939.

malignant obstruction to the lower part of the common bile duct. The presence of jaundice and a distended gallbladder may suggest obstructive jaundice due to carcinoma of the head of the pancreas or of the bile ducts below the orifice of the cystic duct, but this combination is by no means pathognomonic. The presence of deep, persistent jaundice, continuous acholia and a distended gallbladder may be considered a more reliable diagnostic complex.

Cachexia and loss of weight usually are symptoms of advanced carcinoma and in most instances will be present in a patient in whom the malignant condition has progressed to the point at which surgical excision of the lesion is no longer possible. It would seem, therefore, that three of the four diagnostic criteria in the symptom complex of Bard and Pic may be misleading, and that if the surgeon should fail to entertain the presumptive diagnosis of cancer of the pancreas in the absence of the typical symptom complex as described by these observers, the golden opportunity to extirpate the lesion may be ignored.

The recognition of malignant lesions when they are situated in the body or tail of the pancreas presents a problem that not infrequently is insoluble except by surgical exploration or at the necropsy table. The patient may have one or more types of pain that have been mentioned previously. The disease may masquerade as a primary lesion in the stomach, biliary tract or bowel, with such symptoms as nausea, vomiting, epigastric distress, bloating, belching and constipation. In rare instances it may be symptomless until the enlarging tumefaction or symptoms from metastatic lesions have become manifest. In others the only complaint the patient may make at examination is gradual loss of weight and strength, which produces the "cancer appearance."

Laboratory data are of inestimable value, particularly in the presence of jaundice. The stools, as a rule, contain no bile, but the urine is deeply bile stained. Examination of freshly voided urine usually will fail to demonstrate the presence of urobilinogen, for this pigment evidently is formed by the action of bacteria on bile pigment and is absent if bile does not reach the intestine. Exclusion of bile from the duodenum may be demonstrated by the examination of duodenal contents, which may contain blood or blood-stained mucous plugs. In the more advanced stages of the disease, blood may be noted in the stool or in the gastric contents, particularly if ulceration into the stomach or bowel has occurred.

Appreciable elevation of the content of lipase in the serum was noted in about 37 per cent of a series of cases of pancreatic cancer by Comfort, Parker and Osterberg.[7] Because this phenomenon probably was due

7. Comfort, M. W.; Parker, R. L., and Osterberg, A. E.: Concentration of Pancreatic Enzymes in Duodenum of Normal Persons and Persons with Disease of Upper Part of Abdomen, Am. J. Digest. Dis. **6**:249-251 (June) 1939.

to obstruction of the pancreatic ducts and/or associated pancreatic inflammation, it was said to be significant in the diagnosis of cancer of the pancreas.

Studies of hepatic function show no remarkable deviation from that seen in obstructive jaundice arising from other causes, such as stone in the common bile duct, stricture, carcinoma of the extrahepatic ducts and carcinoma of the ampulla of Vater, except perhaps in degree, for alteration of hepatic function is dependent on damage to the parenchyma of the liver. Hepatic injury of the greatest magnitude would be expected in the presence of complete occlusion of the common bile duct.

In the absence of obstruction of the common bile duct and pancreatic duct (the situation that would obtain when a carcinoma of the pancreas was small and situated in the body or the tail of the pancreas) the diagnostic value of laboratory data is negligible. An increased sedimentation rate may be of significance, particularly in a person who has experienced loss of weight and strength, who has complained of indefinite distress in the upper part of the abdomen, who presents the "cancer appearance," who has low grade fever and in whom results of all available clinical and laboratory examinations have shown insignificant variations from normal. In such a person, the diagnosis of cancer of the pancreas must be considered.

The recognition of carcinoma of the islands of the pancreas may present an insoluble diagnostic problem, for it is well known that even though surgical exploration of the pancreas is carried out, an adenoma or carcinoma of the islet cells is not always demonstrable and definitely incriminated as the cause of a patient's spontaneous hyperinsulinism and associated hypoglycemia. The liver apparently is the sole regulatory mechanism for the maintenance of sugar in the blood, and therefore rather profound changes in carbohydrate metabolism would be expected in the presence of severe hepatic disease. That alteration of this important physiologic process of the liver in the presence of hepatic disease occurs only infrequently is evidence that the hepatic cells are able to function effectively when severely damaged, or that relatively few normal hepatic cells are capable of maintaining within normal limits the content of sugar in the blood. Mild degrees of hypoglycemia have been reported in cases of hepatic disease. Our experience has shown that increased excretion of galactose may occur when acute cellular damage has arisen, and that hypoglycemia occasionally may be present when the liver is extremely fatty and cirrhotic. It has been reported that the value for blood sugar has been low in the presence of Addison's disease, in hypothyroidism, in certain forms of hypopituitarism, in progressive muscular atrophy and in status thymicolymphaticus, although the decrease of sugar in the blood rarely has caused symptoms in these diseases. The clinical syndrome ascribed to hypoglycemia is well known. It may be provoked

when the sugar in the blood has been lowered sufficiently by the injection of insulin, and is marked especially by tremor, tachycardia, convulsions and coma. Although occasional instances of hypoglycemia undoubtedly are hepatogenic, the minimal reduction of sugar in the blood in itself rarely causes symptoms, and therefore the spontaneous occurrence of the clinical syndrome ascribed to hypoglycemia should make the physician acutely aware of the possibility of a benign or malignant islet cell tumor.

In review of the records of patients with this unusual disease, it is interesting to note that an appreciable number are familiar with the fact that sugar will abort an attack and have become accustomed to carrying candy or sugar with them at all times. The attack of hypoglycemic coma may be mistaken for drunkenness by the average layman, and it has not been an unusual experience to find that a patient has been discharged from his position on the mistaken assumption by his employer that he had been imbibing too freely.

SURGICAL TREATMENT OF CARCINOMA OF PANCREAS

Indications for Operation.—Surgical treatment would seem to be indicated in practically all cases in which the presence of a carcinoma of the pancreas has been recognized, if for no other reason than to offer palliative relief from a condition that is unbearable. In view of the fact that the majority (60 to 70 per cent) of malignant tumors of the pancreas are situated in the head, and that most of these produce complete and persistent jaundice, the surgeon is justified in attempting to restore the flow of bile into the stomach or intestine if it is seen that radical removal of the tumor cannot be effected.

Should there be any uncertainty as to the diagnosis, a period of observation may be indicated in order to permit determination of the general course of the disease. Hepatogenous jaundice of the toxic or infectious type generally follows a painless course; the degree of jaundice will be variable, and early evidence of hepatic functional disturbance will become manifest. The reaction to the van den Bergh test will be direct; bile will be present in the stool and urine, and urobilin and urobilinogen will be detected in the stool and urine. The course of patients who have malignant biliary obstruction (carcinoma of the head of the pancreas, the biliary ducts or the gallbladder) will be painless in about 60 per cent of cases; the degree of the jaundice will be deep and constant; the gallbladder frequently will be palpable; pruritus and cachexia will be severer, and hepatic damage will become manifest later than in the case of hepatogenous type of jaundice. The reaction to the van den Bergh test will be direct; bile will be absent from the stool but will be present in the urine, and urobilin and urobilinogen will not be detected in the stool or urine. A recapitulation of some of these clinical and laboratory features may serve to clarify the situation (table).

In spite of these features which assist greatly in differentiating between the hepatogenous type of jaundice and malignant biliary obstruction, it may not be possible to make a correct diagnosis. Every effort should be made, however, to make the distinction, because the patient with the hepatogenous type of jaundice is more likely to be harmed than benefited by operation.

In the absence of jaundice, the diagnosis of carcinoma of the pancreas is extremely difficult to make, and therefore the indications for surgical

Factors Considered in Differential Diagnosis of Hepatogenous Jaundice and Obstructive Jaundice Due to Carcinoma of the Head of the Pancreas

Clinical or Laboratory Feature	Pathologic Condition: Hepatogenous Jaundice	Pathologic Condition: Obstructive Jaundice (Carcinoma of Pancreas)	Normal Condition
Painless course	Usually	Approximately 60 per cent	.....
Degree of jaundice	Variable	Deep and persistent	.....
Evidence of hepatic functional disturbance	Early	Later	.....
Serum bilirubin	Increased, direct reaction	Markedly increased, direct reaction	Negative, direct reaction
Bile in duodenal drainage	Present	Absent	Present
Bile in stool	Present	Absent	Present
Bile in urine	Present	Present	Absent
Urobilin and urobilinogen	Present in stool and urine	Absent from stool and urine	Present in stool and urine
Plasma cholesterol and cholesterol esters	Reduced (esters)	Increased (plasma cholesterol)	160-200 mg. and 110-145 mg., per 100 cc.
Total serum protein	Reduced; reversed albumin-globulin ratio	Normal	6.8 Gm. per 100 cc.
Serum phosphatase	Normal	Increased	5 units or less per 100 cc.
Galactose tolerance	Reduced (3 Gm.+)	Normal	Less than 3 Gm. excreted in 5 hours
Excretion of hippuric acid in urine	Reduced (2 Gm. or less)	Normal	More than 3 Gm. (4 hour specimen)
Retention of dye	Increased	Increased	None
Cephalin flocculation	Increased	Normal (usually); increased late	No flocculation
Thymol turbidity	6-8 units or more	Normal	0-4 units
Quick prothrombin time	Normal or prolonged	Prolonged	17-19 seconds
Serum lipase	Normal	Increased	Minimal or none
Serum amylase	Normal	Increased	Less than 320 units

intervention are obscure. The decision to explore will have to be made when other diagnoses have been discarded through a careful process of elimination. It is probable that more patients should undergo exploratory operations than are at present, for by such a course it will be possible to attack the disease when it is still amenable to surgical removal.

Preoperative Preparation.—The patient who has obstructive jaundice caused by carcinoma of the pancreas should be prepared for surgical operation as is done when obstruction of the common bile duct has

occurred from any source. Because of the complete absence of bile from the intestinal tract, one of the fat-soluble vitamins, vitamin K, is not absorbed by the blood stream, and consequently the formation of prothrombin in the liver may be reduced to such an extent that the deficiency of prothrombin in the plasma is critical. Frequently associated with the hypoprothrombinemia is hemorrhagic diathesis; every effort should be made to correct this tendency toward bleeding before any surgical procedure is attempted. The relative amounts of prothrombin in the plasma of different patients may be estimated by the Quick test,[8] in which oxalated plasma is clotted with an arbitrarily fixed amount of calcium and an excess of thromboplastin. Normal plasma, by this test, clots in ten to twelve seconds. The K vitamins are substituted naphthoquinones with complicated side chains. The related synthetic forms are obtainable in aqueous solution ready for parenteral injection, and therefore do not require bile salts for their absorption. Daily administration of the synthetic form of vitamin K should be carried out until the prothrombin time has been reduced to normal limits. A high carbohydrate, high protein, low fat diet should be prescribed, and anemia, if present, should be corrected by the administration of fresh whole blood. Repeated observations have been reported by which it has been shown that stored blood will lose practically all prothrombin in a very few hours. In the presence of hypoprothrombinemia, the importance of obtaining blood which has a normal content of prothrombin is obvious. The intravenous administration of dextrose, protein digest and preparations of vitamins B complex and ascorbic acid has been found advantageous.

Operative Treatment.—An excellent review of the various operative procedures that have been devised for the radical removal of carcinoma of the head of the pancreas has been made by Brunschwig. Although Whipple was not the first successfully to resect the head of the pancreas, the duodenum and the distal portion of the common bile duct, much credit is due him and his associates for the present widespread interest in the radical surgical treatment of malignant lesions of the ampulla and head of the pancreas.

Whipple, Parsons and Mullins[9] described their first operation in 1935. This consisted of a two stage procedure in which gastroenterostomy and cholecystogastrostomy were carried out at the initial operation. In the second operation, a portion of the duodenum, the head of the pancreas and the distal portion of the common bile duct were excised en bloc, the common bile duct was ligated and the duodenum was closed just distal to the pylorus and also behind the excised portion.

8. Quick, A. J.: The Hemorrhagic Diseases and the Physiology of Hemostasis, Springfield, Ill., Charles C Thomas, Publisher, 1942.

9. Whipple, A. O.; Parsons, W. B., and Mullins, C. R.: Treatment of Carcinoma of Ampulla of Vater, Ann. Surg. **102**:763-779 (Oct.) 1935.

Recurring cholangitis evidently afflicted these patients, so that in 1938 a second operation was described by Whipple,[10] which was also based on the two stage principle. At the first stage, ligation of the common bile duct and gastroduodenal artery was done, and end to end cholecystojejunostomy was carried out, with use of the Roux Y principle. At the second stage, a block of tissue was excised, as was done in the second stage of the first operation, and side to side gastroenterostomy was performed. In both operations, the cut end of the duct of Wirsung (and the duct of Santorini, if found) was ligated, and the wedge-shaped defect in the head of the pancreas was obliterated by approximation of the two surfaces with interrupted fine silk sutures.

Since the publication of these two operations, many modifications have been presented, and from them two rather important changes have received wide acceptance: (1) It has been found that use of the gallbladder is not so satisfactory as the use of the distal portion of the common bile duct in restoration of the flow of bile, and (2) it has been found that an effort should be made to reimplant the cut end of the remaining portion of the pancreas into the stomach or bowel.

One reason that the use of the gallbladder did not prove satisfactory was the fact that approximately 25 per cent of cystic ducts will be observed to run parallel to the common bile duct for a variable distance. Should this anatomic arrangement exist, ligation of the distal portion of the common bile duct may include the cystic duct. In any event, the gallbladder, by reason of its anatomic features, does not drain as well as does the common bile duct.

Two reasons of prime importance for reimplantation of the cut end of the remaining portion of the pancreas into the stomach or bowel are that (1) the external secretion of the pancreas thus will continue to flow into the intestine, where it assists materially in the digestive processes, and (2) there is less likelihood of the development of a pancreatic fistula.

An arbitrary method cannot be utilized in every case, for the surgeon will find it is necessary to improvise in order to meet the varying situations as he finds them. If the distal portion of the duodenum cannot be brought up so as to permit invagination of the pancreas into the end of the duodenum, the jejunum can be utilized, as was done in Whipple's second operation, and the distal portion of the common bile duct can then be inserted into the side of the jejunum at the most convenient location. Waugh [11] showed that after the pancreas and duodenum are mobilized completely from their vascular attachments, gentle traction on the latter will permit the upper part of the jejunum to slide under

10. Whipple, A. O.: Surgical Treatment of Carcinoma of the Ampullary Region and Head of the Pancreas, Am. J. Surg. **40**:260-263 (April 1) 1938.

11. Waugh, J. M.: Resection of the Head of the Pancreas and Duodenum: Operative Technic, S. Clin. North America **26**:941-948 (Aug.) 1946.

the superior mesenteric vessels and through the opening occupied by the third portion of the duodenum, and it will then be possible to establish anastomosis of the end of the pancreas and common bile duct with the bowel, without tension. Complementary cholecystostomy was recommended, and the tube was to be left in place two or three weeks.

If the tumor is situated in such a position that it can be completely excised without disturbance of the head of the pancreas, the problem is simplified, because local excision is sufficient. Great care should be exercised in suturing the cut end of the remaining portion of the pancreas in order to minimize the possibility of pancreatic drainage.

Postoperative Care.—Postoperative care usually presents no insurmountable problem. Some type of constant drainage should be provided from the proximal limb of the jejunum or duodenum through a Levin tube. Vitamin K preparations should be administered until the jaundice has ceased completely. The patient's subsistence on a high carbohydrate high protein, low fat diet should be continued for an indefinite period. Waugh noted that diabetes may develop after removal of a portion of the pancreas, and advocated examination at frequent intervals during the immediate postoperative period, and occasionally later for glycosuria and elevation of the value for blood sugar. With the reduction of pancreatic juice, the patient may require some agent in substitution therapy, such as pancreatin, in an effort to control the bulky, fatty stools and to assist in utilization of the main food elements, which depends to a large extent on the action of pancreatic enzymes.

COMMENT

The advent of modern surgical technic and methods has brought about innumerable advances in all fields of surgery. That such a situation obtains in surgery of the pancreas is evidenced by the increasing number of reports appearing in the medical literature, and it is to be hoped that progress in this field will continue, so that the patient who has cancer of the pancreas may be given even a greater opportunity to overcome this grave malady.

Division of Surgery, the Mayo Clinic.

ACUTE OBSTRUCTION OF THE COLON

With Special Reference to Factors of Mortality

MARSHALL L. MICHEL, M.D.
NEW ORLEANS
AND
EMIT L. McCAFFERTY, M.D.
MOBILE, ALA.

THERE is probably no better commentary on the present status of obstructive conditions of the large bowel than Bruusgaard's [1] statement in connection with the 13 deaths in the 91 cases of volvulus he was reporting from the Ullevaal Hospital. Fourteen and two-tenths per cent was, he remarked, "a satisfactory rate." It is true that he immediately qualified the remark by saying that it was a satisfactory rate considering the advanced age of most of the patients and the poor physical state of many of them. Nonetheless, the status of a disease can scarcely be regarded as satisfactory if one must be resigned to what amounts to 1 death in every 7 cases, especially if it is remembered that volvulus does not carry the highest mortality rate of obstructive conditions of the large bowel. That dubious distinction goes to malignant obstruction.

Isolated series of cases of acute obstruction of the large bowel might not seem to warrant such pessimism. Wangensteen,[2] Dennis [3] and their associates, for instance, report a remarkably low mortality rate for all varieties of the condition. Brindley's [4] report from the Scott and White Clinic of only 7 deaths in 34 cases of acute malignant obstruction of the colon is as commendable as it is unusual. Such figures are not representative. Results similar to these are achieved only by care-

---

From the Department of Surgery, School of Medicine, Tulane University of Louisiana.

Read before the Section on Surgery, General and Abdominal, at the Ninety-Seventh Annual Session of the American Medical Association, Chicago, June 23, 1948.

1. Bruusgaard, C.: Volvulus of the Sigmoid Colon and Its Treatment, Surgery **22**:466-478 (Sept.) 1947.

2. Wangensteen, O. H.: Primary Resection (Closed Anastomosis) of the Colon and Rectosigmoid, Surgery **14**:403-432 (Sept.) 1943.

3. Dennis, C.: Treatment of Large Bowel Obstruction: Transverse Colostomy—Incidence of Incompetency of Ileocecal Valve; Experience at the University of Minnesota Hospitals, Surgery **15**:713-734 (May) 1944.

4. Brindley, G. V.: Acute Obstructions of the Colon, Texas State J. Med. **40**:571-577 (March) 1945.

ful treatment based on sound physiologic and surgical principles and carried out by small groups of thoroughly trained and highly competent surgeons. It may be a truism to point out that the mortality rate of most surgical conditions is based on the mortality at all hospitals and not on that at a selected few and on the rate found by all surgeons and not on that found by certain small groups, but it is nonetheless true that the mortality rate of acute obstruction of the large bowel is calculated on that basis.

The 103 cases of acute obstruction of the large bowel which we are reporting herewith from all services of two New Orleans hospitals (over a five year period at the Charity Hospital of Louisiana at New Orleans and over a seven year period at Touro Infirmary) represent, we fear, a true picture of this type of intestinal obstruction. There were 30 deaths in the 103 cases (29.1 per cent), the distribution ranging from no deaths in 5 cases of diverticulitis to 24 (32.4 per cent) in 74 cases of acute malignant obstruction.[5]

The purpose of this communication is to determine, from an analysis of this unhappily typical material, why the mortality rate of obstruction of the large bowel has shared so little in what Wangensteen [2] has called "increments of gain" in intestinal surgery, these increments being the result of various technical, chemotherapeutic and physiologic advances which have so materially reduced the mortality in elective surgery of the large bowel in recent years.

GENERAL CONSIDERATIONS OF MORTALITY

Age.—Aside from any other consideration, the cards, as Bruusgaard [1] intimated, are stacked against the patient with acute obstruction of the large bowel for a number of reasons, the first of which is that he is likely to be advanced in years. It should be stressed that carcinoma may occur in young subjects, as it did in 11 patients between 13 and 40 years of age in this series (15 per cent). On the other hand, the majority of the patients whose ages were known (fig. 1) were 50 years of age and

5. Omitted from this analysis are 6 cases of colocolic intussusception, 1 of which was fatal, and 10 other cases of acute obstruction of the large bowel, 4 of which were fatal, which occurred in these hospitals during the periods of the study and were caused, respectively, by incarcerated sliding inguinal hernia (2 cases), metastatic carcinoma (2 cases), mesocolic thrombosis, internal hernia, prolapse of a colostomy, postoperative adhesions, nonspecific colitis and postoperative stricture following extraperitoneal closure of a colostomy. The inclusion of these 16 cases, with 5 deaths, would raise the mortality rate in this series from 29.1 to 29.4 per cent. They are omitted, however, because intussusception, regardless of its location, is almost a specific condition and because the other causes of obstruction are extremely unusual. They must always be borne in mind as possibilities, but they may fairly be omitted from a consideration of the common causes of acute obstruction of the large bowel.

over, and almost half were between 70 and 86 years of age. It is something more than coincidence that 90 per cent of the deaths involved the group of patients over 50 years of age and that two thirds occurred in the group over 70 years of age.

Cause of Obstruction.—The second adverse circumstance in acute obstruction of the large bowel is that in most series, as in this one, the

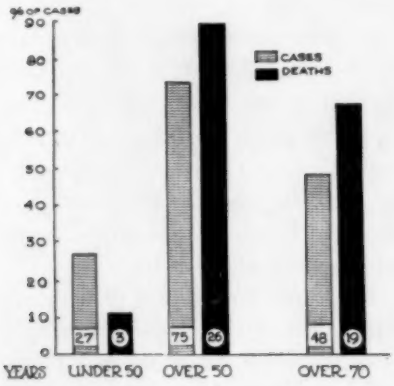

Fig. 1.—Age distribution in 102 cases of acute obstruction of the large bowel. The age was not stated in 1 (fatal) case of the series.

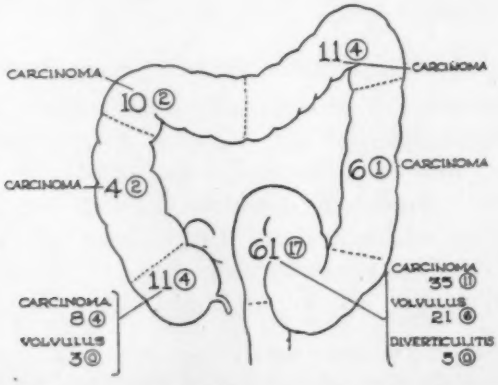

Fig. 2. Regional distribution of primary causes in 103 cases of acute obstruction of the large bowel.

predominant cause of the occlusion is carcinoma (fig. 2). In this series 74 of 103 obstructions (71.8 per cent) were from this cause. Most of the patients were therefore in double jeopardy. They had a potentially lethal disease associated with a potentially lethal complication. Moreover, after the complication had been cared for by an emergency procedure, their chances of ultimate survival required a radical elective procedure for the removal of the malignant growth. The danger was

greatly increased, as will be pointed out later, by attempts to combine the emergency and elective phases of treatment.

General Status.—In this series, as in most similar series, the combination of advanced age and serious causative disease meant, aside from any other consideration such as duration of illness, that the majority of the patients (60 per cent) did not present the best possible surgical risk (fig. 3). The further consequence of these combined adverse circumstances was that the death rate rose progressively from 12.2 per cent in the good risk group to 70 per cent in the poor risk group. The figures may be too small to be statistically significant, but no surgeon of experience would dispute their clinical significance.

It is easy to understand the disparity in the distribution of surgical risks. The patient with carcinoma of the large bowel, whether he knows it or not, has been ill for a long time. The malignant growth has been

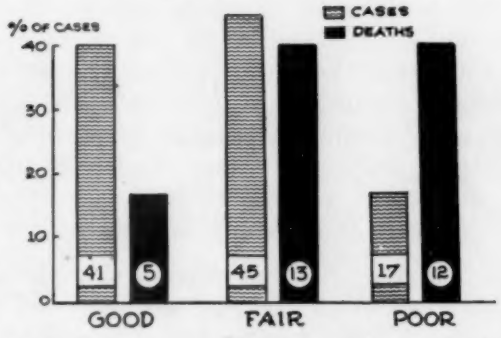

Fig. 3.—Distribution of cases and deaths in relation to surgical risk in 103 cases of acute obstruction of the large bowel.

slowly sapping his strength and vitality, reducing his hemoglobin content and red blood cell count, reducing his plasma protein level and perverting his hepatic function. He has frequently survived, to use Wangensteen's [2] excellent term, by becoming "autocannibalistic"; that is, by living on his own fat stores. When metastasis has occurred, as it is known to have occurred in 12 cases in this series (the small number being explained by the small number of explorations and autopsies), the patient's resistance is likely to be particularly low.

The patient with diverticulitis is also frequently in none too good a condition. He is likely to have a history of previous illness and to present the picture of chronic infection, with its associated disabilities. The patient with volvulus, on the other hand, may have had recurrent attacks of obstruction,[6] but the progressive debilitation so frequent in

6. Michel, M. L., and McCafferty, E. L.: Volvulus of the Colon: An Analysis of Twenty-Four Cases, South. Surgeon, to be published.

carcinoma of the large bowel and not infrequent in diverticulitis is not usually present in patients seen promptly.

The age of the majority of patients with acute obstruction of the large bowel makes them susceptible to the constitutional diseases which develop as life advances, while their prolonged illness gives rise to physiologic disturbances. Fourteen patients in this series, for instance, had clearcut cardiovascular, cardiorenal or renal disease, and 13 had significant degrees of hypertension. Twenty-one had pronounced degrees of secondary anemia, and 15 had pronounced degrees of hypoproteinemia; had these been looked for in the examination of all the patients, the numbers would undoubtedly have been much larger.

Age, constitutional disease and physiologic disabilities are no longer insuperable obstacles in elective surgery of the large bowel, but their presence in cases of acute obstruction is a different matter. There is no time in cases of acute obstruction in which vascular impairment threatens for complete replacement of carbohydrate, protein, vitamin and hemic deficiencies, no time for irrigations and no time for full chemotherapeutic and antibiotic protection. The debility produced by the primary disease and by the patient's advanced age therefore constitutes the surgical risk, while the most careful preoperative preparation is necessarily incomplete by the standards one would employ in elective intestinal surgery.

SPECIAL FACTORS OF MORTALITY

Errors in the Concept of Acute Obstruction of the Colon.—Important as are the considerations which have just been discussed, there are more fundamental reasons for the continued high mortality rate of acute obstruction of the large bowel. The first of these is the unfortunately prevalent concept that intestinal obstructions are all alike, regardless of where they are located. This is not true. Obstruction of the large bowel and obstruction of the small bowel are two separate diseases. They frequently overlap, involvement of the small bowel usually occurring eventually in any case of obstruction of the large bowel which persists long enough. An obstruction of the cecum frequently involves the terminal part of the ileum from the onset. Clinical manifestations are often misleadingly similar. However, the dissimilarities so far outnumber the similarities and the differences are so basic that many surgeons, among whom we are numbered, are of the opinion that continued discussion of the two conditions as if they were a single entity helps to explain the continued high mortality rate of acute obstruction of the large bowel.

The differences between obstruction of the large bowel and obstruction of the small bowel may be briefly summarized as follows:

1. The cause is essentially different. In the great majority of series of obstruction of the large bowel, as in this one (fig. 2), carcinoma is the

chief cause, with volvulus a less important cause and diverticulitis rather uncommon. Volvulus, however, is an uncommon cause of obstruction of the small intestine, and carcinoma is an extremely uncommon cause. The usual etiologic factors are postoperative adhesions or incarceration or strangulation of hernias, which are seldom responsible for obstruction of the large bowel.

2. Acute obstruction of the colon, in contrast to obstruction of the small bowel, frequently takes the form of a closed loop. When once the loop is closed, distention of the colon is rapid, because each downward peristaltic wave forces the contents of the ileum into the cecum, while the ileocecal valve, if it is competent, as it is in 50 to 60 per cent of all cases,[3] prevents regurgitation of the cecal contents into the ileum. As distention within the loop increases by this purely mechanical process, edema of the intestinal wall, thrombosis, ulceration and infection occur successively and perforation is the inevitable result if surgical intervention is not undertaken. Perforation occurred in 2 cases in this series in these circumstances. Perforation of the small bowel does not usually occur in the absence of extensive gangrene, but macroscopic gangrene is not present in the majority of the perforations associated with acute obstruction of the large bowel.

3. The pronounced chemical changes which ensue so promptly in obstruction of the small bowel, such as alkalosis, acidosis, hemoconcentration, azotemia and hypochloremia, are late phenomena in obstruction of the large bowel. Anemia and decreased serum protein, as already mentioned, are frequently present as part of the primary disease in colonic obstruction but are not characteristic of early obstruction of the small bowel. Leukocytosis, with an increased proportion of polymorphonuclear leukocytes, appears relatively early in obstruction of the large bowel and relatively late in obstruction of the small bowel.

The Therapeutic Error.—The second fundamental reason for the continued high mortality rate of obstruction of the large bowel arises from the first. If the concept of the disease is incorrect, that is, if obstruction of the large bowel is not regarded as a clinical entity and as essentially different from obstruction of the small bowel, therapy is also likely to be incorrect. The results in this series make the possible disasters of incorrect therapy unmistakeably clear:

1. Intestinal decompression with the Miller-Abbott tube is of no permanent curative value in acute obstruction of the large bowel and is, on the contrary, a highly dangerous form of treatment.[7] This method was employed as the first therapeutic step in 34 patients in this series, 15

7. Michel, M. L.: Acute Malignant Obstruction of the Large Bowel: An Analysis of Fifty-Five Cases, South. Surgeon **13**:299-320 (May) 1947.

of whom died. In 24 cases, 9 of which were fatal, the tube did not enter the small intestine. In the 10 cases in which it did, the patients were temporarily improved, the surgeon apparently experienced a false sense of security, operative measures were withheld longer and 6 of the 10 patients died. Both of the patients whose surgeons persisted in conservative measures lost their lives. In the other 32 cases, including 9 of the 10 in which the tube entered the small intestine, surgical intervention for complete relief of the obstruction was eventually carried out, but the patient's chances were, of course, seriously jeopardized by the delay.

2. That conservative therapy has no place in the treatment of acute obstruction of the colon is indicated by the fact that 5 of the 9 patients for whom it was used in this series did not survive. The surgical therapy of obstruction of the large bowel is also diametrically opposed to that of obstruction of the small bowel. In the treatment of practically all varieties of obstruction of the small bowel, a direct surgical attack on the obstructive lesion is indicated, and the surgical relief of the obstruction usually also eradicates the cause of the occlusion. An internal or external hernia, for instance, can be repaired at once, the adhesions producing an obstruction can be released, an obstructing gallstone can be removed or primary resection can be carried out for obstructing neoplasms.

In most cases of obstruction of the large bowel the situation is entirely different. Correction of a volvulus, which is a purely mechanical obstruction, is properly accomplished by a direct manipulative procedure,[8] but in malignant obstruction and in obstruction caused by diverticulitis the wise surgeon takes as his motto *noli me tangere*. The compulsion to handle the causative lesion is a common blunder which should be firmly resisted. Because it was not resisted in at least 5 cases in this series (2 of diverticulitis and 3 of carcinoma), perforation of the bowel occurred in the course of operation.

Another temptation which the surgeon should resist is immediate resection of an obstructing malignant or infectious lesion of the large bowel. The safety of elective resections of the colon does not hold for acutely obstructive lesions. The figures in this series make that clear (fig. 4). There were 8 deaths in the 18 cases in which immediate resection was performed, and 2 of the patients who survived operation had no chance of permanent cure, for the pathologist reported that both growths were incompletely removed.

In contrast to the poor results of primary resection in this series are the results in the 29 cases in which secondary resection was carried out after emergency surgical decompression. There were only 2 fatalities in this group, 1 of which was the result of an embolus. The patients had all been saved from death from intestinal obstruction by simple surgical

decompression of the bowel and had been subjected to elective resection when they had been properly prepared for the ordeal and no longer were in jeopardy from a highly fatal complication.

Surgical decompression is the proper treatment of acute obstruction of the large bowel, but judgment must be exercised as to the method employed. Ileostomy alone is not a proper procedure.[7] It is useful in obstruction of the right side of the colon as an adjunct to ileotransverse colostomy, but the 2 deaths in the 3 cases in which it was used as an independent procedure in this series are evidence of its lack of efficacy.

The 11 deaths in the 37 cases in which cecostomy was performed in this series (fig. 4) indicate that this mode of decompression is also

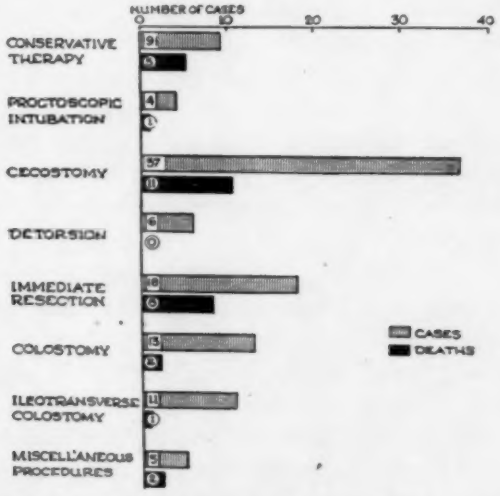

Fig. 4.—Distribution of therapeutic procedures in 103 cases of acute obstruction of the large bowel.

far from satisfactory. That cecostomy is a simple procedure which is frequently lifesaving in obstruction of the left side of the colon cannot be denied. It has, however, numerous disadvantages and dangers.[7]

Cecostomy for obstruction of the right side is, of course, a different matter. It is permissible whenever the obstructing neoplasm is in the ascending colon, the hepatic flexure or the right side of the transverse colon. On the other hand, it should not be performed if the lesion is in the cecum or in the ileocecal region. That principle was not violated in this series.

That the least that can be done in obstruction of the large bowel is the best for the patient is well shown by the figures in this series. Intubation, for instance, under proctosigmoidoscopic visualization is a satisfactory method of treatment of volvulus of the sigmoid if it is cer-

tain that gangrene has not occurred (fig. 4); that precaution was overlooked in the single case in which death occurred among the 4 in which the method was used in this series.[6]

There were only 3 deaths in the 13 cases in which colostomy was performed and only 1 death in the 11 cases in which ileotransverse colostomy was performed (fig. 4). Three of the colostomies were performed in the sigmoid, which, although all the patients survived, is not a desirable site because the fixation of the left side of the colon makes for technical difficulties when later resection must be undertaken. The Devine colostomy, which was done in 3 cases, with 1 death, affects decompression adequately but is an unduly complicated procedure which has no advantage over simple loop colostomy and which increases the risk by prolonging the operative time. Transverse colostomy, which was used in only 7 cases, 1 of which was fatal, is the simplest and safest of all methods of decompression.[7]

Ileotransverse colostomy, which was performed in 11 cases of acute malignant obstruction in this series, with 1 death, is the procedure of choice in this type of obstruction of the right side of the colon. If the ileocecal valve is competent, some type of cecal decompression is necessary also, for ileotransverse colostomy alone does not relieve a closed loop obstruction.

Duration of Illness.—Since carcinoma and diverticulitis of the colon are both diseases which have existed for varying periods, with or without recognition, before obstruction occurs, statements concerning the effect of the duration of illness are not likely to be accurate. Moreover, in this small series the number of cases in each time category is not statistically significant. There is obvious significance, however, in the fact that in 46 cases in which the duration was from three to seventy-two hours there were only 11 deaths (23.9 per cent) and that none of the 6 patients died who were seen within six hours of the onset. However, 18 (34.6 per cent) of the 52 patients seen after seventy-two hours died.

Surgical measures were delayed in a number of cases after the patients were hospitalized, though it is not always possible to say whether the delay was for the purpose of carrying out conservative treatment or was the result of diagnostic error.

In the 29 fatal cases in which the duration was known the illness had lasted from thirty-six hours to twenty-one days when the patients entered the hospital. In 10 of these cases in which the duration before admission had ranged from thirty-six hours to fourteen days, operation was done promptly. In the other 19 cases delays ranging from twenty-four hours to sixteen days occurred in the hospital. It is not possible to set the upper limit of safe postponement of surgical treatment for a patient with acute obstruction of the large bowel, but it is certainly

considerably less than a week, and it therefore seems fair to say that delay in resorting to operation was a potent cause of the fatality in these 19 cases.

THE PHYSICIAN'S ERROR IN ACUTE OBSTRUCTION OF THE LARGE BOWEL

Acute obstruction of the large bowel is not a common condition. The 103 cases which make up this series occurred over periods in which the combined number of patients admitted to Charity Hospital of Louisiana at New Orleans and Touro Infirmary was 337,606 and in which the number admitted for general surgical conditions was 59,528.

This extremely small incidence seems to have important implications. The 103 cases in this series were handled by 40 surgeons, including

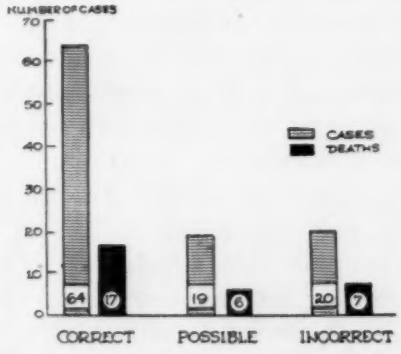

Fig. 5.—Clinical diagnostic data in 103 cases of acute obstruction of the large bowel.

27 residents and 16 members of the hospital staffs. One staff member handled 9 cases, and one resident handled 8, but, at the other extreme, 24 surgeons handled 1 case each. In other words, the incidence of acute obstruction of the large bowel is so low that even an experienced surgeon can have no really extensive experience with it. The comment can also fairly be made that surgeons whose chief experience is in the field of obstruction of the small bowel are likely to use that experience in the occasional cases of obstruction of the large bowel which come their way unless they continuously remind themselves of the possible existence of the latter condition.

Diagnostic Error.—In these 103 cases of obstruction of the large bowel the correct clinical diagnosis was made in 64, was considered as a possibility in 19 and was not considered at all in 20 (fig. 5). An analysis of the clinical picture helps to explain the high incidence of diagnostic error.

The outstanding symptom of acute obstruction of the colon is inability to defecate and to expel flatus, but this is not always the initial symptom. In 18 cases in this series the patients passed gas or feces after the onset of their illness. Vomiting is generally but not always present in cases of acute obstruction of the colon. It was absent throughout the illness in 16 of the patients in this series. In both groups delay occurred because, it would seem, the clinical picture was not the classic one and the surgeon was apparently waiting for it to assume that form. One result of the delay was that in 17 cases, 9 of which were fatal, obstruction became complete in the hospital while the diagnostic survey was being carried out.

Carcinoma, diverticulitis and occasionally volvulus are all insidious diseases. All present somewhat the same clinical picture.[8] The differential diagnosis, therefore, is not always easy. If it cannot be made, the important consideration would seem to be (1) to recognize that an acute intestinal obstruction is present and (2) to recognize that the obstruction is located in the large bowel and not in the small one. When these two factors are realized, surgical exploration is likely to be undertaken at once even if the academic satisfaction of a perfect differential diagnosis is missing.

In cases of obstruction of the sigmoid it is not so serious an error to confuse carcinoma and diverticulitis as it is to confuse carcinoma and volvulus or diverticulitis and volvulus. It is also a less serious error to make a diagnosis of volvulus in cases of carcinoma or diverticulitis than to diagnose carcinoma or diverticulitis when the correct diagnosis is volvulus. The safest plan, if the exact diagnosis is not possible, is to make the exploratory incision in the left lower quadrant. If that plan is followed and carcinoma or diverticulitis should prove to be present, the incision can be promptly closed and loop colostomy can be performed in the right side of the transverse colon through a small transverse incision in the right upper quadrant. If the right side of the abdomen is opened first, on the other hand, it is possible, because of imperfect visualization, to overlook the true condition present. That happened twice in this series, both times in cases of volvulus of the sigmoid; in 1 of the cases autopsy revealed that death had been caused by perforation of a gangrenous loop of the twisted bowel.

The most serious errors in the diagnostic study of these patients, and those for which there seems the least excuse, were failure to use roentgenograms, particularly those made after a barium enema, and the inadequate interpretation of many of the roentgenograms which

8. Michel and McCafferty.[6] Michel.[7]

were made. We present the figures (fig. 6) with some hesitancy, for they are likely to suggest wrongly that the mortality was actually higher when roentgenographic methods were used. The explanation of the apparently higher death rate is that roentgenography was most frequently resorted to in cases in which the diagnosis was obscure, these being chiefly the cases in which the patients, because of previous delay and for other reasons, were not in good condition.

Flat roentgenograms of the abdomen are of somewhat limited usefulness in obstruction of the large bowel because, as Teitelbaum [9] has emphasized, they are not specific and frequently do not indicate either the exact level of the obstruction or the nature of the etiologic agent. In numerous cases in this series the radiologist merely reported multiple fluid levels and made the general diagnosis of intestinal obstruction. This is not enough. If careful study of the scout film does not

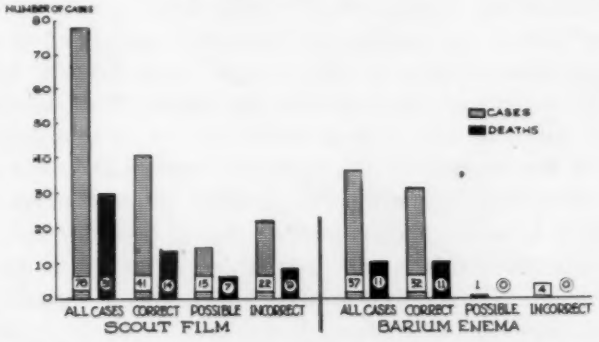

Fig. 6.—Roentgenologic diagnostic data in 103 cases of acute obstruction of the large bowel.

reveal the information, an effort must always be made to localize the site of obstruction and to ascertain the possible cause by the use of a barium enema.

A barium enema, which is extremely useful in all forms of obstruction of the large bowel, was used in just over a third of the cases in this series (fig. 6), but the diagnosis was correct in 32 of the 37 cases in which it was employed. This method is of particular value in malignant obstruction of the colon. It was used, however, in only 25 of the 74 cases of this disease, in 24 of which the diagnosis was correct. Certain precautions are, of course, always necessary when it is employed.[7]

Barium is useful when introduced by rectum, but it should never be given by mouth if obstruction of either the large bowel or the small bowel is suspected. If it is, incomplete obstruction may be converted

9. Teitelbaum, M. D.: The Roentgen Diagnosis of Acute Intestinal Obstruction, New Orleans M. & S. J. **95**:157-168 (Oct.) 1942.

into a complete obstruction, the presence of barium in the bowel may greatly complicate the operation and the risk of perforation is always present. There were 2 fatalities in the 3 cases in this series in which barium was given by mouth, in 1 of which the patient died of fulminating peritonitis following conservative therapy; postmortem examination revealed two perforations, one in the transverse colon and one in the sigmoid.

The 20 cases in this series in which the diagnosis was not correct fall into four groups when they are analyzed in connection with roentgenologic diagnosis. In 6 of the 20 cases no roentgenograms were taken. In 4 of these the diagnosis was acute appendicitis and immediate operation was performed, all the patients surviving. In the fifth case conservative therapy was employed after an incorrect diagnosis of peritonitis following appendicitis or pelvic inflammatory disease was made. Autopsy revealed gangrene and perforation of a volvulus of the sigmoid. In the sixth case, in which the diagnosis of obstruction of the small bowel was made, operation was performed promptly but the malignant growth causing occlusion of the colon was incompletely removed by immediate resection and the patient thus lost his chance of ultimate survival. In 7 cases in which the clinical diagnosis was incorrect the roentgenologic diagnosis was inconclusive, and in 5 cases both the clinical and the roentgenologic diagnosis was incorrect. There were 2 deaths in each group. In the other 2 cases the roentgenologic diagnosis was correct but was disregarded in favor of the incorrect clinical diagnosis. In the first case carcinoma of the sigmoid was diagnosed as obstruction of the small bowel and conservative therapy was followed by death. In the second case volvulus of the sigmoid was diagnosed as carcinoma and cecostomy was followed by death from perforation of a gangrenous loop of bowel. These 2 cases emphasize, in reverse, Teitelbaum's [9] warning that surgical exploration must not be delayed because of negative roentgenologic findings if there is any suggestion of strangulation obstruction.

Diagnostic and Therapeutic Errors Prior to Hospitalization.—Three patients with volvulus of the large bowel had been treated by physicians before they were admitted to the hospital with acute obstructions. One had been treated for "stomach trouble" for several years, and another had been operated on for chronic appendicitis after a period of treatment. A review of the histories suggests that both had had recurrent attacks of volvulus which had not been recognized. The third patient, who did not survive, was thought to have pelvic inflammatory disease before she entered the hospital, where the diagnosis was thought to be peritonitis from that condition or from appendicitis.

Twenty-two patients with carcinoma of the large bowel which later terminated in acute obstruction also sought medical aid from their own

physicians for periods varying from eleven days to eighteen months before they entered the hospital. It is tragic that they either received no aid at all or received the wrong kind. Six patients, 3 of whom died, were treated with enemas and laxatives for periods varying from ten days to a year. One, who did not survive, was treated for thirteen months with oral medication the nature of which could not be determined. One was treated for hemorrhoids. One patient who died was treated for six months for a gastric ulcer without having roentgenologic study. Three were treated for periods ranging from three weeks to five months for disease of the biliary tract; 1 of them did have cholelithiasis in addition to the malignant process in the colon. Two had been treated for dysentery, 1 for acute hepatitis and 1 for diverticulitis for varying periods. One patient who died had been treated for "womb trouble" for a month. Three had been subjected to appendectomy (through buttonhole incisions) two weeks, nine months and sixteen months respectively before the present acute illness. Finally, 1 patient had been operated on eighteen months earlier for a partial obstruction of the colon thought to be caused by adhesions, and 1 had been subjected to cecostomy six months earlier for a supposed volvulus of the cecum.

There seems little doubt that the symptoms experienced by all these patients were caused by the malignant disease which finally terminated in acute obstruction. The conclusion further seems inevitable that in most instances there was not the slightest attempt to study the patients exhaustively and to arrive at an accurate diagnosis, though they presented one or two or all of the well known triad of symptoms of malignant disease of the colon, namely, cramping abdominal pain, altered bowel function and melena. Even in the surgical cases all the evidence suggests that more exhaustive study before operation or more adequate exploration when the abdomen was opened might have led to the correct diagnosis and permitted earlier radical intervention. The end results of the delay and mistreatment were what might have been expected. Six of the 22 patients died in hospital, and only 10 of the remainder were subjected to procedures from which permanent cure could be expected.

SUMMARY AND CONCLUSIONS

Acute obstruction of the large bowel is a rather uncommon, highly fatal form of intestinal obstruction.

General explanations of the continued high mortality rate include the advanced age and the poor condition of most patients, their poor condition most often being caused by the debilitating effects of carcinoma, the most frequent cause of obstruction. Diverticulitis, a much less frequent cause, produces the debilitating effects of chronic infection.

Basic reasons for the high mortality rate include (1) the general failure to regard acute obstruction of the large bowel as a distinct

entity entirely separate from acute obstruction of the small bowel and (2) the therapeutic error which follows this misconception. Diagnostic error, which could be avoided by more frequent and more accurate use of roentgenograms, particularly after barium enemas, is surprisingly frequent.

An analysis of 103 cases of acute obstruction of the large bowel from two New Orleans hospitals bears out the statements just made and points the way to improvement, which can be achieved by (1) recognition of the existence of an acute surgical emergency rather than prolonged attempts at exact differential diagnosis and (2) limitation of emergency surgical treatment to as little as need be done to accomplish decompression. Conservative therapy and immediate resection of malignant and infected lesions are equally disastrous.

DISCUSSION

DR. C. DENNIS: Dr. Michel and Dr. McCafferty are to be congratulated on their honest recognition of the problems which have been faced in the management of these cases. Their analysis of the difficulties runs closely parallel to ours at the University of Minnesota.

Their emphasis on the clinical and radiologic differentiation between obstruction of the large bowel and obstruction of the small bowel is most in order. The physician who treats obstruction of the small bowel nonoperatively accepts a greater responsibility than the one who operates in all cases, but by this margin he increases the safety of his patient. Because he must be constantly at hand for emergency exploration in cases of ileac obstruction and because, as Dr. Michel and Dr. McCafferty have so aptly emphasized, he must regard complete colic obstruction as an acute surgical emergency, it is only sensible that all cases of bowel obstruction should be in the hands of the surgeon from the first.

The radiologic distinction between colic and ileac obstruction can be confusing. In an effort to clarify the point, Dr. Leo Rigler, Dr. O. H. Wangensteen and I undertook several years ago to analyze a series of 41 cases in which the roentgenograms were available. In about one third of the cases all apparent gas lay in the distended colon. In about another one third there was a minimal amount in the terminal end of the ileum. In about another one third there was colic distention as in the others but definite ileac distention was also present. Finally, in a small fraction of the cases (7 per cent) the ileac distention was more striking than the colic distention.

We have had misfortune with the use of barium mixture in cases of complete and nearly complete colic obstruction. It is surprising with what frequency the medium easily flows proximately past the lesion without arousing the suspicions of the radiologist. A case was observed recently at the Minneapolis General Hospital to which a barium enema was given without staff consultation. The roentgenogram suggested no lesion until after attempted evacuation, when an obstructing stenosis in the descending colon became painfully evident. In 5 of 54 cases the obstruction was made complete in just this manner.

Study of the upright and flat roentgenograms taken on the admission of this particular patient suggests the diagnosis. No gas is apparent in the sigmoid or the lower end of the descending colon, and the transverse colon is markedly distended. In other cases perforation of the colon close to the lesion has occurred during barium enema examination.

It is our impression that barium mixture should be used only when volvulus is suspected and cannot be proved and then it should not be pushed past the sigmoid colon. When there is serious doubt about volvulus, an initial incision low in the left side works well, as Dr. Michel and Dr. McCafferty suggest.

In cases of lesions involving the ileocecal valve and the right side of the colon below the hepatic flexure the crampy pain and the associated borborygmi frequently come more often than every ten minutes, just as in cases of obstruction of the small bowel. This is a treacherous lesion if the cecum is distended, as early perforation is prone to occur. For such lesions, aseptic decompression (Wangensteen) through the terminal end of the ileum and immediate resection with closed anastomosis may often be done safely.

Decompression for lesions of the right side of the colon presents a problem when the cancer is fixed or when the patient is unable to withstand primary resection. Here ileostomy is less well tolerated than division of the terminal end of the ileum and the transverse colon, restoration of bowel continuity by end to end closed anastomosis and exteriorization of the stumps communicating with the lesion. The resection can be cleanly done with less risk three weeks later.

For the treatment of almost all other lesions, our group at the University of Minnesota is in agreement with Dr. Michel and Dr. McCafferty that a transverse colostomy through a transverse incision across the right upper rectus is far superior to any other procedure.

As the authors have so properly emphasized, most cases of complete, neoplastic colic obstruction can be precluded by an alert attitude on the part of the home physician. Patients in the cancer age group suffering a bout of distention and temporary obstipation who respond to enemas and oil or who complain of a change of bowel habits should not be sent home with pills but should be carefully studied.

DR. G. V. BRINDLEY: I am going to emphasize some of the facts ably presented in this excellent paper. Certainly, obstructions of the large intestine and obstructions of the small intestine are two distinct pathologic entities and present entirely different problems from several aspects. It is vital to recognize that the etiology, the symptoms and the treatment of obstruction of the small bowel are different from those of obstruction of the large bowel. It should be emphasized that the Miller-Abbott tube cannot be relied on to decompress an obstructed colon and, furthermore, that a surgical decompression is the only means of relieving an obstruction of the large intestine. Experience proves that a primary resection of the colon should never be done in the presence of an acute obstruction caused by a malignant lesion or even by an inflammatory process because it is unnecessary and the mortality is prohibitive. Since the majority of obstructions of the large intestine are due to neoplasms, it should be recognized that the patients have two conditions, one an acute process demanding immediate treatment, and the other a slowly developing chronic lesion present for months. Therefore, it is imperative that treatment should be directed to the relief of the acute condition, the one of chronic nature being disregarded for the time being.

Since there is such a difference in the management of obstruction of the large bowel and obstruction of the small bowel, emphasis must be placed on the value of roentgenologic examinations in the differentiation of these two conditions. The value of a scout film of the abdomen when obstruction is suspected should be appreciated more; a competent roentgenologist can usually determine whether an obstruction is present and, if so, whether the small or the large bowel is involved.

Unquestionably, it is always injudicious to give barium by mouth in a case in which obstruction of the intestinal tract is considered likely. Sometimes, when there is a question of the existence of an obstruction, a small barium enema is

indicated. Examination should be restricted to that necessary to make the diagnosis and evaluate the patient's condition. Observation of patients with acute obstruction of the colon prompts the statement that delay in instituting surgical decompression is a definite factor contributing to the high mortality of obstruction of the colon. Surgical decompression should seldom be delayed longer than a few hours after the patient has been admitted to the hospital. Furthermore, it is believed that many lives are lost by the manner in which a surgical decompression is done. It should be performed with little manipulation and certainly without exploration. A number of patients are best operated on by the use of a local anesthetic. We would give consideration to a cecostomy and an ileotransversostomy for the decompression of the lesions of the right side of the colon and to a cecostomy and transverse colostomy for obstruction of the left side of the colon. A transverse colostomy will more completely decompress an obstruction of the left region of the colon than will a cecostomy, and it is the procedure which we usually use. However, in some cases and particularly when the patient is gravely ill, a cecostomy may be the preferable procedure. The safety and the value of a cecostomy for decompressing an acutely obstructed colon would seem to be substantiated by the fact, as previously reported, that 46 consecutive cecostomies have been performed at Scott and White Hospital, with only 4 deaths, a mortality of 8.7 per cent. When dealing with a gravely ill patient, it is often wise to do the practical rather than to attempt to achieve the ideal. The most important agent contributing to increased intraluminal tension is gas within the intestine. For the profoundly sick patient, decompression for the acutely obstructed, gas-distended colon by means of a cecostomy performed with the patient under local anesthesia frequently will prove lifesaving.

DR. MARSHALL L. MICHEL: I wish to thank Dr. Dennis and Dr. Brindley for their discussion.

As Dr. Dennis has emphasized, in many of these cases the scout film will show only a distention of the colon. This, as Dr. Wangensteen and Dr. Dennis have pointed out is due to a competent ileocecal valve.

In our cases of acute obstructive carcinoma of the colon we found that colic distention alone, with minimal or no distention of the small bowel, was present in approximately 40 per cent of the roentgenograms. In such cases vomiting is uncommon. The diagnosis may be delayed, and perforation is apt to occur.

In acute colic obstruction, the barium enema, if given carefully, is a valuable procedure. In the 37 cases in which it was performed in this series no complications occurred. The barium enema will demonstrate not only the site of obstruction but frequently also the cause, thus rendering exploration unnecessary. However, as Dr. Dennis has emphasized, in cases of obstruction of the sigmoid colon in which the cause is questioned and in which the possibility of volvulus arises the lower left quadrant should be opened first. The diagnosis can then usually be made merely by inspection of the colon and not by palpation.

As Dr. Dennis has indicated, delay in diagnosis is an important mortality factor in this type of intestinal obstruction. This is explained largely by the fact that the onset is often insidious—much more so than in the average case of obstruction of the small bowel. This applies particularly to obstructions from carcinoma.

Volvulus of the colon is the only type of colic obstruction in which the onset of the condition is accompanied with violent, acute abdominal pain, as Dr. Brindley has emphasized.

We strongly agree that exploration in all cases of colic obstructions should be limited to a minimum.

SURGICAL ANATOMY OF THE ANAL CANAL

J. E. DUNPHY, M.D.
BOSTON

THE DESCRIPTIONS of anal anatomy in current textbooks on surgery and proctology are remarkably diverse. Not only are there departures in terminology, but in many instances details of considerable surgical significance are not given proper emphasis or are omitted entirely. The need for clear and uniform concepts has led to this presentation of the essential points with which he who ventures to dissect the nether parts of his fellow man should be familiar. It is based on certain fundamental contributions to this subject,[1] tempered by a personal study of postmortem and surgical material.

THE ANAL MUSCULATURE

The four muscles of importance in anal surgery are the external sphincter, the internal sphincter, the longitudinal muscle and the levator ani. It is amazing how frequently the relationship of these muscles is misrepresented, despite the thorough and conclusive studies of Milligan and Morgan,[1a] Blaisdell [1b] and others. The proper relationship is well shown in textbooks on anatomy, but frequently in surgical textbooks, particularly in relation to the surgical treatment of fistulas, alterations are introduced to fit the preconceived ideas of the author and old errors are perpetuated.

The external sphincter of the anus is a cylindric muscle which surrounds the anal canal, the internal sphincter and the longitudinal muscle. It extends from the anal canal upward to the lower border of the levator ani, to which it is intimately attached. As is shown in the photomicrograph (fig. 1) and in figures 2 and 3, the external sphincter is composed of three fairly well differentiated portions, separated by fibromuscular septums which are prolongations downward of the longitudinal muscles. Beginning with the lowest and proceeding upward, the divisions of the external sphincter are referred to as the

From the Surgical Service, Peter Bent Brigham Hospital, and the Department of Surgery, Harvard Medical School.

1. (*a*) Milligan, E. T. C., and Morgan, C. N.: Surgical Anatomy of the Anal Canal, Lancet **2**:1150, 1934. (*b*) Blaisdell, P. C.: Operative Injury to Anal Sphincter, J. A. M. A. **112**:614 (Feb. 18) 1939.

subcutaneous, superficial and deep portions respectively. The horizontal relations of the muscle are shown in figure 4 *A*.

The subcutaneous and deep portions are annular muscles completely encircling the canal, without significant attachment or prolongation to the coccyx or the median raphe. The subcutaneous portion of the external sphincter is an annular band which closely embraces that portion of

Fig. 1.—Photomicrograph of a cross section of the anal canal. *A*, internal sphincter; *B*, external sphincter; *C*, longitudinal muscle; *D*, levator ani. Compare with drawings in figures 2 and 3.

the anal canal below the line of the internal sphincter. It can be palpated as a distinct muscle bundle, and the cleft between it and the internal sphincter is readily identified as the intersphincteric line. The superficial portion of the external sphincter is elliptic, being composed of two lateral halves, which fuse anteriorly and posteriorly to form

fibromuscular attachments to the coccyx and the central point of the perineum (fig. 4*A*). It. lies somewhat laterally between the deep and the subcutaneous portion of the muscle.

The deep portion of the external sphincter is composed of an annular muscle bundle of considerable size. Its upper edge is readily palpated anteriorly, but laterally and posteriorly it fuses with the lower border of the levator ani (puborectalis) and is indistinguishable from

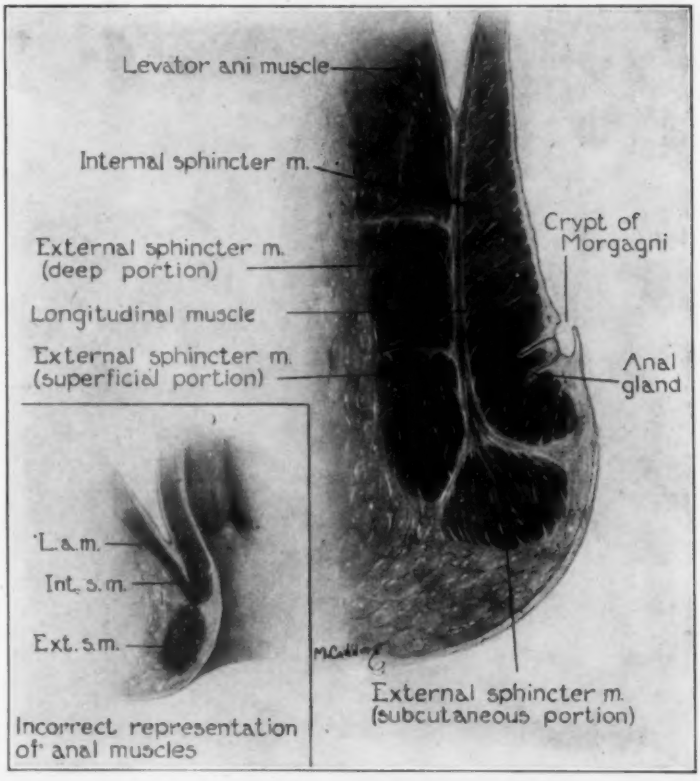

Fig. 2.—Anatomic relationships of the anal canal in cross section. Insert illustrates a common misconception.

it. Anteriorly, the muscle bundles decussate with each other, but some fibers pass laterally into the substance of the superficial transversus perinei. The deep portion of the sphincter embraces the internal sphincter and the longitudinal muscle and extends upward beyond the pectinate line (fig. 2).

The levator ani plays an important role in rectal function, and its anatomic relations have an important bearing on the surgical treatment of anal fistulas. This huge muscle spreads out in a fan-shaped fashion from its origins anteriorly on the pubis, ischium and obturator fascia

to form the pelvic floor (fig. 4 *B*). Its more posterior fibers, which insert in the coccyx and in the anococcygeal raphe, have no effect on the anal canal. The more anterior fibers, the puborectalis, pass from the pubis and the triangular ligament backward and downward, embracing the posterior and lateral aspects of the anal canal in a powerful sling. Its fibers are intimately attached to the deep portion of the external sphincter ani, and together with it constitute a principal guardian of anal continence. The surgical importance of the levator lies in the fact that it supports the anal canal only posteriorly and laterally, leaving an area of comparative weakness anteriorly.

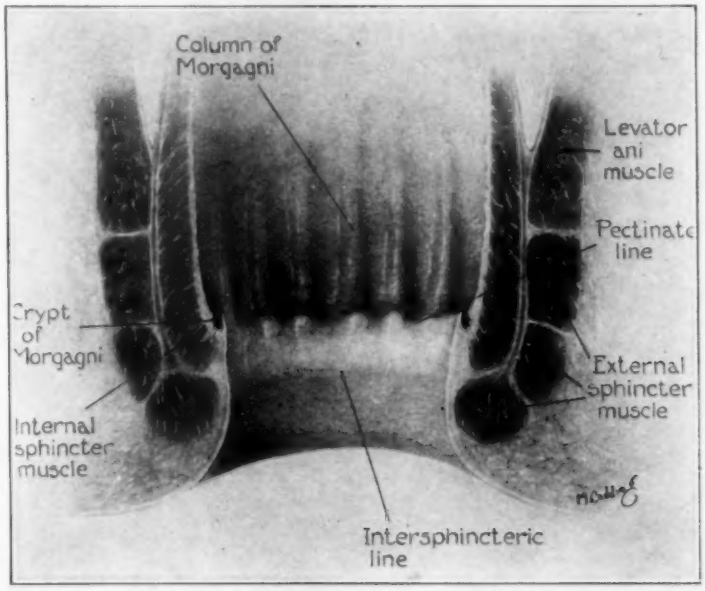

Fig. 3.—Relationship of muscles to anal and rectal mucosa.

The longitudinal muscle of the anus is a prolongation of the longitudinal muscle coat of the rectum. It is easily identified in cross section as a thin fibromuscular band separating the internal and the external sphincter (figs. 1, 2 and 3). It has a fibrous attachment to the levator ani posteriorly and to the deep portion of the external sphincter anteriorly. At its lower end it splits up into several septums, which mark the divisions of the external sphincter. The upper septums pass into the ischiorectal fat, but the lower ones, those passing between the internal sphincter and the subcutaneous portion of the external sphincter, are attached to the skin in the vicinity of the anal verge. The septums of the longitudinal muscle constitute potential channels for infection

spreading from the anal glands, and in most instances the main tract of a fistula will be found to correspond to one of these tissue planes (fig. 5).

The internal sphincter of the anus is composed of smooth muscle fibers. It is a downward prolongation of the circular muscle coat of

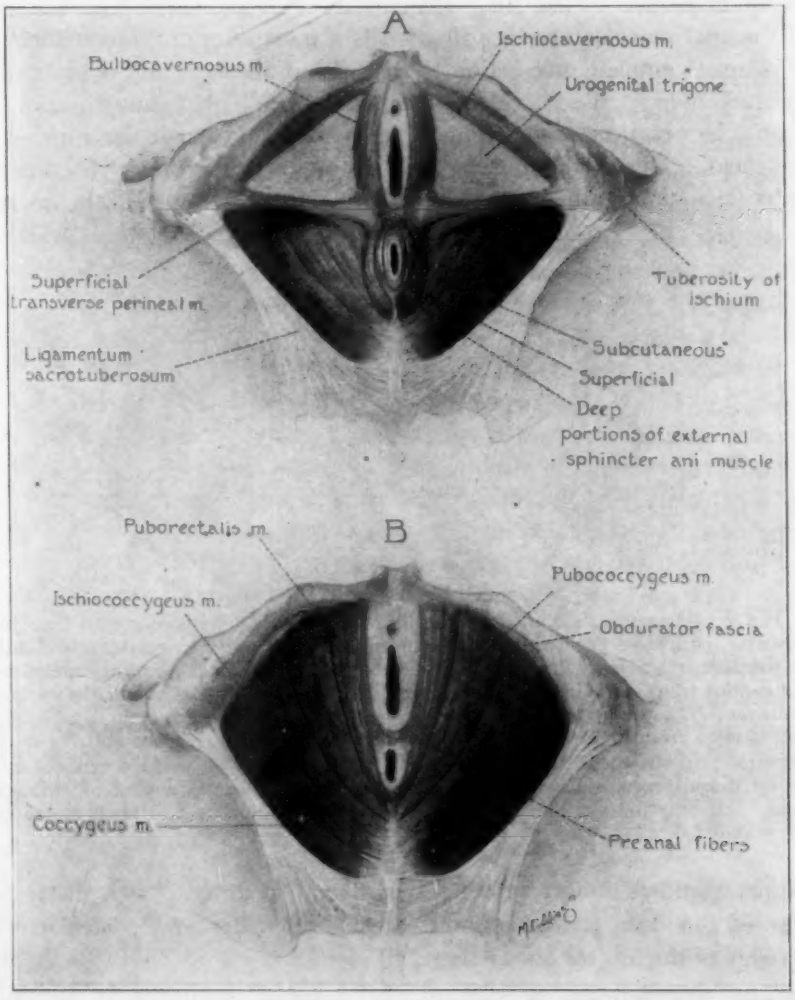

Fig. 4.—*A*, horizontal relations of the anal muscles. *B*, levator ani. Note that the puborectalis grips the canal in a stout sling laterally and posteriorly. Anteriorly there is an area of comparative weakness (after Milligan and Morgan [1a]).

the rectum. Its lower edge is thickened and is readily felt just above the subcutaneous external sphincter. The depression between them marks the intersphincteric line.

At the upper end of the anal canal the internal sphincter, the longitudinal muscle, the levator ani posteriorly and the deep portion of the external sphincter anteriorly combine to form a firm fibromuscular ring. The term anorectal ring has been given to this point by Milligan and Morgan. It constitutes the strongest point in the anal canal. Its division produces incontinence.

Identification of the Anal Musculature by Palpation.—Identification of the anal musculature by palpation is a most advantageous maneuver. It assures complete orientation to the field at all times and is practically indispensable in the successful treatment of a high fistula in ano. It should be practiced and taught by all who have a particular interest in this field. The parts which can be distinguished are the subcutaneous external sphincter, the intersphincteric line, the lower edge of the internal

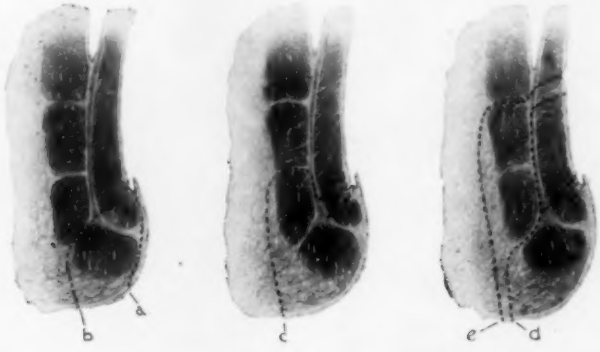

Fig. 5.—Drawing showing how the tracts of anal fistulas conform to the fibromuscular pathways created by the longitudinal muscle. *A*, submucous fistula; *B*, fistulous tract involving the subcutaneous portion of the external sphincter; *C*, fistulous tract involving the subcutaneous and superficial portions of the external sphincter; *D*, fistulous tract with a secondary opening into the rectum; *E*, fistulous tract arising from a perforation of the rectal wall and involving the entire external sphincter. In all these fistulas the entire sphincter may be divided without producing incontinence, since the levator ani provides sufficient support for the anal canal. An anterior fistulous tract, as in *E*, would require a two stage operation. See text for details.

sphincter and the anorectal ring, corresponding anteriorly to the upper edge of the deep portion of the external sphincter and posteriorly to the edge of the levator ani (puborectalis).

The subcutaneous portion of the external sphincter is felt just beneath the skin at the inner aspect of the anal verge. It is a circular or slightly elliptic muscle bundle which can be rolled under the finger throughout the entire circumference of the anal opening. At its upper edge there is a distinct depression, the intersphincteric line, above which the lower edge of the internal sphincter is felt. When the finger is introduced into the rectum and hooked around the entire sphincter

anteriorly, it lies in contact with the anorectal ring, supported only by the deep portion of the external sphincter. If the finger is kept in contact with this muscle at this exact level and then carried laterally and posteriorly, a distinct thickening will be felt as the levator ani becomes attached to the anal wall. Posteriorly it will be necessary to introduce the finger a bit farther in order to mark the upper edge of the ring, at which point it will be in contact with the levator ani (puborectalis).

LINING OF THE ANAL CANAL

The anal canal is a tubular structure about 3 cm. in length which extends from the skin of the buttocks to the lower end of the rectum. In its lower portion it is lined by stratified squamous epithelium which, except for the absence of hair and sweat glands, resembles skin. At about the middle point of the canal the stratified squamous epithelium changes abruptly to a transitional type only three or four cells in thickness. This continues to the upper end of the canal, where it joins the columnar epithelium of the rectum. At the juncture of the anal canal and the rectum are found the anal papillae and the anal crypts (figs. 2 and 3). The former are teatlike prolongations of the anal epithelium extending upward onto the longitudinal folds of rectal mucosa, referred to as the columns of Morgagni. The latter are blind pockets behind transverse plicae which connect the lower edge of the columns of Morgagni. The anal papillae and crypts vary in size and depth, and occasionally are absent. Their arrangement gives a somewhat serrated or comblike appearance to the juncture of the anal canal and the rectal mucosa. An appropriate term for this is the pectinate line (fig. 3).

The abrupt change from squamous to transitional epithelium corresponds to the point described by Hilton as the "white line." It is more easily recognized by palpation than by visualization because it corresponds to the lower edge of the internal sphincter ani. The distinct depression which can be felt between this muscle and the subcutaneous portion of the external sphincter is referred to as the intersphincteric line (fig. 3).

The term "mucocutaneous junction" should be abandoned. It is applied by some to the junction of the skin of the buttocks with the anal canal, by others to the intersphincteric line and by still others to the pectinate line. Its misuse has occasioned so much confusion that it will clarify the situation enormously if it can be dropped entirely. Only the terms pectinate line, intersphincteric line and, as suggested by Buie [2] for the junction of the anal canal with the skin of the buttocks, "anal verge" should be used.

---

2. Buie, L. A.: Practical Proctology, Philadelphia, W. B. Saunders Company, 1937.

At the base of the anal crypts there are small tubular, branching glands which extend into, and sometimes through, the substance of the internal sphincter. It is obvious how readily infection developing in one of these glands can extend through the internal sphincter and thence along the channels created by the longitudinal muscle to produce an ischiorectal abscess or fistula (figs. 2 and 5).

SURGICAL APPLICATIONS

There are several points of surgical importance in connection with the anal musculature. Atrophy, fibrosis and contraction of the subcutaneous external sphincter produce a tight annular ring at the entrance to the anal canal. This condition is commonly encountered in the

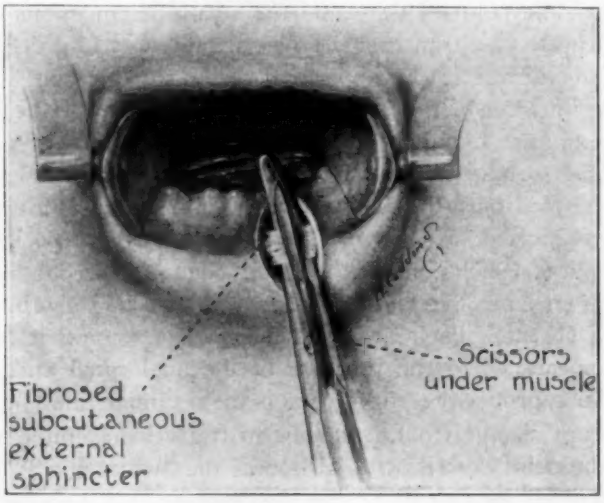

Fig. 6.—Technic of division of subcutaneous portion of external sphincter.

chronically constipated person addicted to use of large amounts of liquid petrolatum U. S. P. or saline cathartics. It is sometimes referred to as "pectenosis," under the mistaken notion that it is a fibrous contraction of the tissue beneath the pectinate line. However, a careful dissection of such contractions indicates that the pathologic process lies within the substance of the external sphincter. Histologic sections of portions of the ring will show fibrous and muscular tissue. Division of the subcutaneous external sphincter, erroneously called pectenotomy, is the proper treatment. As shown in figure 6, the incision should be made slightly to the right or the left of the midline posteriorly in order to avoid injury to the fibers of the superficial external sphincter which decussate in the midline and attach to the coccyx. Dilation of a fibrous sphincter is effective but sometimes causes sufficient hemorrhage to

produce recurrent fibrosis. Simple division of the band is the procedure of choice. After division of the muscle, the previously stenotic canal will easily admit one or two fingers. If not, it will be found that division of the stenotic sphincter has been incomplete and more fibers should be cut until the sphincter relaxes.

The branching fibromuscular septums at the lower end of the longitudinal muscles make natural channels through the substance of the external sphincter along which an inflammatory process may travel. It is easy to see how an abscess arising in an anal gland can find access to these septums and travel along them to the skin. Most fistulas will be found to run along the course of these septums. Some of the various possibilities are shown in figure 5. An appreciation of these is of material help in the development of a fistulous tract surgically.

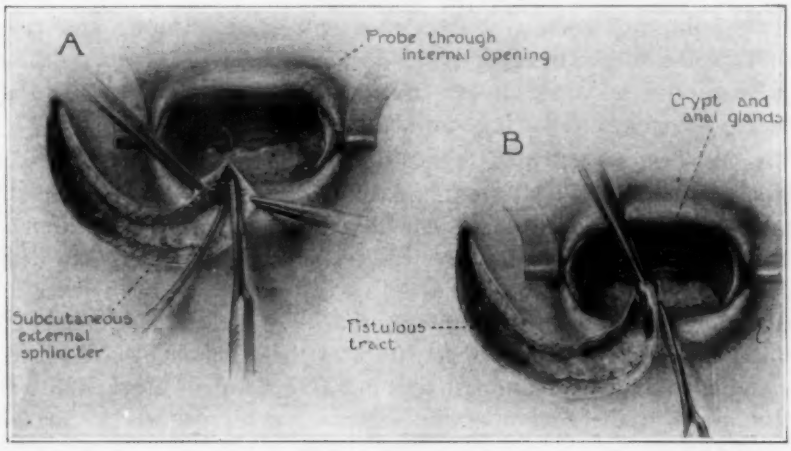

Fig. 7.—*A*, Excision of fistulous tract. *B*, The walls of the tract must be excised in the region of the internal opening in order to extirpate abscessed anal glands, which are the commonest cause of this condition.

In dealing with anal fistulas, it is a common error to regard the subcutaneous and superficial portions of the external sphincter as the entire muscle. Actually these portions can be divided with impunity, provided the deep portion of the muscle is left intact. Posteriorly and laterally, the deep portion of the external sphincter can be divided also, because the levator ani provides sufficient support to prevent incontinence. It thus is of the greatest importance for the operator to be able to identify the precise point at which the levator leaves the anal canal without its support. Since the various muscles are best identified by palpation, the complete relaxation provided by spinal anesthesia may be a disadvantage when one is dealing with a high or complicated fistula.

So long as the anorectal ring (deep external sphincter anteriorly, levator ani posteriorly) is left intact, there is sufficient support to the anal canal to prevent undue separation of the muscles, with subsequent incontinence. It is thus necessary to resort to two stage operations for a fistula only when the tract extends above the anorectal ring. Since the majority of fistulas arise from infections in the anal glands and follow the potential channels created by the fibromuscular septums of the longitudinal muscle, it is evident that complete division of the anorectal ring should rarely be necessary. One would expect complete involvement of the anorectal ring in cases of fistulas which arise from pathologic processes in the wall of the rectum above the upper end of the anal canal, namely, ulcerative lesions and perforations by foreign bodies (fig. 5).

It is well established that infection in the anal crypts is the principal cause of anal fistula and ischiorectal abscess. In 95 per cent of the cases the internal opening of the fistula will be found in an anal crypt. However, the role of the anal glands in the pathologic sequences leading to fistula is not accorded proper consideration, and failure to do so is a cause of recurrence following surgical treatment for fistula.

It was first shown by Herrmann [3] and later by Tavel [4] that small tubular structures extend from the base of the anal crypts deep into the substance of the internal sphincter ani (fig. 2). That pathologic processes leading to fistulas arise within these glands rather than in the crypt itself has been demonstrated in a careful study by Tucker and Hellwig.[5] It is obvious, therefore, that the successful treatment of fistulas is dependent on the extirpation of these channels. Thus, it is not enough to find the internal opening of a fistulous tract; the walls of the tract in the region of the internal opening must be carefully excised (fig. 7).

SUMMARY

The anatomy of the anal canal is described in detail. Particular emphasis is placed on certain features which are not fully appreciated and which have an important bearing on the surgical treatment of this region. Surgical procedures on certain of these structures are illustrated.

---

3. Herrmann, G.: Sur la structure, et le developpement de la muqueuse anale, J. d. l'anat. et de la physiol. **16**:434, 1880.

4. Tavel, E.: Cystische Entartung der Sinus Herrmann und Genese der Analfisteln, Deutsche Ztschr. f. Chir. **62**:399, 1902.

5. Tucker, C. C., and Hellwig, C. A.: Histopathology of the Anal Crypts, Surg., Gynec. & Obst. **58**:145, 1934.

ORTHOPEDIC SURGERY IN THE ARMY AIR FORCES DURING WORLD WAR II

II. Recurrent Dislocation of the Shoulder and Ununited Fractures of the Carpal Scaphoid

J. VERNON LUCK, M.D.
LOS ANGELES
HUGH M. A. SMITH, M.D.
MEMPHIS, TENN.
HENRY B. LACEY, M.D.
COLUMBUS, OHIO
AND
A. R. SHANDS Jr., M.D.
WILMINGTON, DEL.

RECURRENT DISLOCATION OF THE SHOULDER

THE WAR years added greatly to the knowledge of recurrent dislocations of the shoulder. In the regional hospitals in the zone of interior, dislocations of the shoulder represented a foremost orthopedic problem.

A large number and variety of operations were carried out to correct recurrent dislocations of the shoulder in soldiers. The numerous cases seen in regional hospitals led Shands [1] to state, "The frequency with which recurrent dislocations are being observed in the army is certainly an indication that something is wrong with what is considered orthodox treatment of the original dislocation."

This has been prepared for publication by the Orthopaedic History Committee of the Office of the Air Surgeon (Major James V. Luck, Medical Corps, Chairman, Chanute Field, Ill.; Major Hugh M. A. Smith, Medical Corps, Santa Ana Army Air Base, Calif.; and Lieutenant Colonel Henry B. Lacey, Medical Corps, Hamilton Field, Calif.) and the Senior Orthopaedic Consultant of the Office of the Air Surgeon, Colonel Alfred R. Shands Jr., Medical Corps, Headquarters Army Air Forces, Washington, D. C. It is a publication of the Surgical Branch of the Professional Division, Office of the Air Surgeon, Headquarters Army Air Forces, Washington, D. C.

These reports were made possible by the following officers: Major General David N. W. Grant, Medical Corps, the past Air Surgeon; Major General Malcolm C. Grow, Medical Corps, the present Air Surgeon; Colonel William P. Holbrook, Medical Corps, past Chief of the Professional Division, and Colonel William H. Powell Jr., the present Chief of the Professional Division, succeeding Colonel Holbrook.

1. Shands, A. R., Jr.: An Analysis of the More Important Information Presented at the Twelve Regional Fracture Orthopaedic Conference of the Army Air Forces, Surgery **16**:569, 1944.

A total of 175 cases of recurrent dislocation will be analyzed in this report. Of this group of cases, in 130, or 74 per cent, the dislocation had existed prior to service (E. P. T. S.). In the remaining 45 cases, or 26 per cent, the original dislocations were incurred in line of duty (L. O. D.). According to army regulations, men with recurring dislocations of the shoulder were not eligible for military service, but the records indicate, nevertheless, that a great number of such men were admitted into the service.

In the early part of the war, Nicola operations (transplanting the long head of the biceps into a tunnel in the humeral head) frequently were performed in the Army Air Forces in order to qualify soldiers, particularly flying personnel, for full military duty. Later in the war it became evident that this was not a sound policy. Results of the Nicola operations were not satisfactory in the more strenuous types of full military duty. In 1944, Shands [1] concluded that ". . . the soldier who has had an operation for recurrent dislocation should never be qualified for full military duty."

During the early part of the war the Nicola [2] operation was the almost universal choice. It had been proved to be superior to any other of the multitude of operations widely used for correction of recurrent dislocations of the shoulder. It was acknowledged that 5 to 20 per cent of the Nicola operations failed, even in the hands of well qualified surgeons. As the war progressed, it became increasingly evident that the percentage of failures in the service was not less than 20 per cent, and among soldiers doing strenuous duty the percentage of failures was even higher.

In the search for a corrective procedure that would withstand combat conditions and strenuous sports, the Bankart [3] operation was tried by several army orthopedists. While the Bankart technic (repair and reattachment of the torn anterior capsule) is admittedly rather complex, it does give promise of standing up under great strain. It is a logical procedure based on the repair of the "essential lesion." The operator actually sees the pathologic condition that represents the cause of the recurring luxations and corrects the defect. Follow-up statistics are not yet adequate critically to evaluate the Bankart operation, but there is much to indicate that it will prove to be the best operation, for soldiers, athletes and laborers.

The sources of trauma to the shoulder, in the order of frequency of occurrence, were: (1) football, (2) falls on the shoulder or the arm, (3)

2. Nicola, T.: Anterior Dislocations of the Shoulder, J. Bone & Joint Surg. **11**:128, 1929; **16**:663, 1934; **24**:614, 1942.

3. Bankart, A. S. B.: Recurrent or Habitual Dislocation of the Shoulder, Brit. M. J. **2**:1132, 1923; The Pathology and Treatment of Recurrent Dislocations of the Shoulder, Brit. J. Surg. **26**:23, 1938.

obstacle courses, (4) calisthenics, (5) lifting heavy objects overhead, (6) swimming, (7) basketball, (8) boxing and (9) judo.

It is apparent that sports were by far the commonest source of recurrent dislocations of the shoulder in the zone of interior training installations. These same sports usually were also responsible for the recurrences of dislocations after corrective surgical treatment.

Indications For Surgical Treatment.—In the majority of instances there was a history of many recurrences, thus leaving no question as to the necessity of some type of corrective procedure. Whenever there had been three or more episodes, it was assumed that a defect existed in the shoulder that predisposed it to dislocation. This generally was

TABLE 1.—*Duration of Symptoms and Incidence*

Duration of Symptoms	Number of Cases	Percentage of Cases
6 mo. to 1 yr	29	16.6
1 to 2 yr	42	24.0
More than 2 yr	98	56.0
Undetermined	6	3.4
Total	175	100.0

TABLE 2.—*Number of Dislocations and Number and Percentage of Cases*

Number of Dislocations	Number of Cases	Percentage of Cases
2	15	8.7
2 to 5	51	29.3
5 to 10	28	16.0
Many (10 to 100 plus)	81	46.0
Total	175	100.0

true even when there had been only two dislocations. In a few cases in which there had been only two episodes and the second had been caused by severe trauma, the question arose as to whether the second episode was a true recurrence or whether it represented an independent dislocation after a completely healed first episode.

In 15 cases in the series there had been only two dislocations, but as a rule the second had occurred without trauma, leading to the conclusion that a permanent defect existed.

In 71 cases, or 41 per cent of the series, the dislocation in at least 1 of the patients was observed by an army physician. But in 94 cases, or 54 per cent of the series, the diagnosis leading to surgical intervention was based entirely on the patient's history. In 22 cases in this

latter group (12.6 per cent of the total series), a physician had never attended the patient, the dislocations being self reduced. At the close of the war it was the conclusion of most orthopedists that surgical treatment should be deferred in all cases in which a physician had not attended one or more of the dislocations. Patients cannot always be depended on to know the difference between dislocations and other types of derangement of the shoulder. Several Army Air Forces orthopedists went further in their requirements and demanded, prior to recommending surgical intervention, that the soldier have at least one of his episodes in the service and that it be observed by a medical officer.

In patients that experienced their original dislocation in line of duty, it was the practice to operate any time after the second episode that the soldier desired to have the operation. No patients in this series were operated on directly after the first episode. However, now that there is a more accurate understanding of the pathologic condition, orthopedists may, in the future, use corrective surgical measures in many cases after the first episode. Nicola now recommends that "in young vigorous individuals" the shoulder should be operated on at the time of the first dislocation.[2]

When there were advanced osteoarthritic changes in the shoulder joint and a long-standing history of many dislocations, operation generally was deferred and the soldier given sedentary work or a certificate of disability discharge (C. D. D.).

A psychologic problem was the basis for deferring operation in many instances, particularly when the original dislocation occurred prior to military service.

Pathologic Changes.—The triad of changes associated with anterior dislocations of the shoulder are now more widely and better understood than they were at the beginning of the war. Credit for this better understanding goes first to Bankart for pointing out the key lesion, a torn and displaced anterior portion of the glenoidal labrum. Credit also goes to Bost and Inman [4] for their thorough investigations that confirmed Bankart's observations.

The three most frequent changes in the shoulder listed in order of importance are: (1) rupture of the glenoidal labrum from its attachment to the anterior margin of the glenoid, (2) posterior-superior defect in the humeral head and (3) denudation, erosion, eburnation or fracture of the anterior lip of the glenoid.

---

4. Bost, F. C., and Inman, V. T.: Pathological Changes in Recurrent Dislocation of the Shoulder: Report of Bankart Operative Procedure, J. Bone & Joint Surg. **24**:595, 1942.

Mechanism of Injury: Injuries occur in the following situations:

1. During falls backward the patient may catch himself on outstretched hands placed back of the body or on flexed elbows. This force drives the humeral head forward, tearing the glenoidal labrum.

2. With the arm abducted 90 degrees or more and externally rotated, a force directed against the front of the arm, driving it backward, often will produce an anterior dislocation, usually with a tear of the glenoidal labrum. In about two thirds of the cases a notch is dug into the posterior-superior aspect of the humeral head, a notch created by the rather sharp edge of the glenoid. Bost and Inman pointed out that the defect of the humeral head may vary from a localized area of cystic change to a deep wedge-shaped notch.

3. Falls on the posterior aspect of the shoulder will drive the shoulder forward.

Joint Capsule.—The anterior capsule may tear at its attachment to the glenoidal labrum, be avulsed with the labrum or tear independently of the labrum at any point between the glenoid margin and the capsular anchorage in the humeral head. In tears at the glenoid, the capsule does not usually separate so extensively that the humeral head becomes extra-articular when it dislocates. Rather, the anterior capsule, including the superior and inferior glenohumeral ligaments, becomes so relaxed that the humeral head slips over the glenoid rim.

In all of the thirty-five Bankart operations in the series herein reported, there were tears in the glenoidal labrum, tears that varied from ½ inch (about 1.27 cm.) in length to the complete length of the anterior margin of the glenoid. Most tears were confined to the inferior two thirds of the glenoid. Similarly in the 27 cases reported by Bankart, and in the 10 cases of Bost and Inman there was a denuded anterior glenoid rim resulting from separation of the glenoidal labrum. Changes in the bone of the glenoid rim varied somewhat. In 13 cases there were changes of sufficient degree to be visible in the roentgenogram. In the cases with a long-standing history of many dislocations, there generally were eburnation of the glenoid anteriorly and degenerative changes in the glenoid articular cartilage in the form of yellowish discoloration, fibrillation and areas of erosion.

In seven of the twenty-six Magnuson [5] operations (transplantation of the subscapularis tendon to the greater tuberosity), the operator reported that the glenoid was explored and showed separation of the glenoidal labrum. The Magnuson approach usually does not give a sufficiently satisfactory view of the glenoid to identify clearly the glenoid pathologic change.

5. Magnuson, P. B.: Treatment of Recurrent Dislocation of Shoulder, S. Clin. North America **25**:14, 1945.

An exposure of the glenoid was not made in any of the Nicola operations, so that the pathologic change in this group was not visualized. However, in an article published in 1942, Nicola [2] recommended that the anterior capsule be explored routinely and its defects repaired in addition to passing the biceps tendon through the humeral head.

Operative Technics.—The following procedures were employed:

	Cases
Nicola operation	94
Bankart operation	35
Magnuson operation	26
Roberts modification of Nicola	16
Henderson (fascial or tendon sling from head of humerus to acromion)	2
Kellogg Speed (bone graft to rim of anterior glenoid)	1
Explored but no corrective procedure carried out	1
Total	175

Several of the Bankart and Magnuson operations were performed in cases in which a Nicola operation had failed. The one Kellogg Speed operation in the series was done in a case in which the operator found it technically impossible to do a Bankart operation as he had planned. In place of anchoring the capsule to the glenoid margin, he inserted a bone graft as recommended by Kellogg Speed.

In the case in which the shoulder was explored, but no corrective procedure carried out, the surgeon observed an enlarged short head of the biceps, but no long head. In place of then doing a Bankart or Magnuson operation, he closed the wound and did no type of corrective procedure. Early in the war there were many young orthopedic surgeons who had never performed nor had they seen any type of corrective operation for recurrent dislocations of the shoulder except the Nicola operation.

In four of the Magnuson operations, the biceps tendon was passed through the humeral head in addition to transplanting the central portion of the subscapularis tendon.

In 1 case a shoulder was explored because of failure of a Nicola operation that had been performed when the patient was a civilian. When the biceps tendon was observed to be ruptured where it entered the humeral head, the surgeon redrilled the hole and passed a strip of the joint capsule through the channel to serve as the tethering agent.

The two Henderson operations were performed in cases in which Nicola operations had failed.

Technical Errors and Technical Difficulties Observed and Recommendations.—The Nicola Operation: In reference to the Nicola operation, the following observations were made:

1. The proximal end of the incision was placed too far below the clavicle, and, as a result, there was great difficulty, even with strenuous retracting, in visualizing the shoulder joint enough to thread the tendon

through the humeral head. The incision should end proximally at the inferior border of the clavicle.

2. Too small a hole was made in the humeral head. Many surgeons labored under the impression that unless the tendon were made to fit tightly in its channel it would not adhere to the humerus and the operation would fail. It has been shown experimentally by Kernwein,[6] and it often has been observed clinically that the tendon can be reasonably loose in its hole at the end of the operation and still fuse securely to its channel wall. A ¼ inch (about 0.64 cm.) hole is adequate for most tendons. The tendon should be entirely freed of its paratendon before it is drawn through the humeral head.

3. Generally there are large veins on each side of the intertubercular ligament. If the ligament is sectioned on one side in place of down its center, hemorrhage ensues that is difficult to control.

4. In closing the capsule, every effort should be made to close the overlying bursae. This permits better mobility of the humeral head against the deltoid muscle.

5. In most cases a deltoid-splitting approach, ½ to ¾ inch (about 1.27 to 1.9 cm.), lateral to the deltopectoral junction, offers a better exposure than does the deltopectoral approach.

6. In 1 case, there was congenital absence of the long head of the biceps and the wound was closed without corrective procedure. A surgeon with knowledge of only one reconstructive procedure for recurrent dislocation of the shoulder should not operate for this entity.

7. If for any reason the tendon cannot be drawn through the drill hole in the humeral head, the gutter down to the hole should not be made. In 2 cases in which this was done, dense adhesions developed and there was severely limited mobility of the shoulder.

8. Nicola modified his original technic by recommending that a strip of joint capsule ½ inch (about 1.27 cm.) wide be drawn through the humeral head along with the biceps tendon. The operative records reviewed indicate that this technic seldom was followed. Most orthopedists interviewed were not aware of this modification.

Bankhart Operation: Technical difficulties were frequently mentioned in the operative reports of the Bankart technic. The first problem encountered during the operation was separation of the subscapularis tendon from the joint capsule. The closer to its insertion the subscapularis tendon was sectioned, the greater was the chance of simultaneously opening up the joint capsule of the shoulder. In 7 of Bost and Inman's 10 cases this was done, and about this same proportion

6. Kernwein, G.: A Study of Tendon Implantation into Bone, Surg., Gynec. & Obst. **75**:794, 1942.

occurred in the thirty-five Bankart operations herein reported. No harm is done by cutting into the joint. In several operative reports the fusion of the subscapularis tendon to the capsule was described as pathologic, but it is entirely normal. Separation of the muscular portion of the subscapularis from the underlying joint capsule often was described as moderately difficult and required careful sharp dissection.

The most difficult step in the Bankart operation was anchoring the capsule to the glenoid margin. A wide variety of methods were recommended to accomplish this step more easily. A contra-angle dental drill was found by several orthopedists to be helpful. Others simplified the technic by anchoring the capsule with pins, staples, wires or screws. Lambert [7] sutured the capsule to the soft tissues over the neck of the scapula.

Most surgeons did not have difficulty reattaching the tip of the coracoid process. In most instances the reattachment was accomplished with nonabsorbable sutures. In a few instances a screw was employed.

In several cases the subscapularis tendon was transplanted across the intertubercular groove during closure in the Bankart operation, thus combining the Bankart and Magnuson technics.

Other Technics: No difficulties were mentioned in reports of the Magnuson, Roberts, Henderson and Kellogg Speed operations.

Causes For Failure of Operations.—All of the failures recorded in this series of cases occurred after Nicola operations. However, most of the Bankart and Magnuson operations were performed during the latter part of the war and an adequate follow-up study was not available.

1. The biceps tendon became severed at its entrance into the humeral head. The shearing and tension stresses on the transplanted tendon at this point can become tremendous. Kernwein [6] has shown that when a tendon passes through a bone the tendon becomes replaced by fibrous connective tissue and this tissue is less strong than tendinous tissue.

2. The biceps tendon was observed to be sliding back and forth in its channel through the humeral head. In all probability this resulted from failure to remove the paratendon and anchor the tendon to the periosteum at its lateral exit from the humerus.

3. The drill hole was made too shallow in the humeral head and lay directly beneath the intertubercular groove. Nicola [2] emphasized the necessity for making the hole at a 45 degree angle and having the articular surface orifice ½ to ¾ inch (about 1.27 to 1.9 cm.) from the lateral border of the articular cartilage.

4. A loop of biceps tendon was seen in the joint; thus, the transplanted tendon furnished no tethering action whatever for the humeral head.

---

7. Lambert, C. N.: Personal communication to the authors.

5. Profound anterior instability resulting from complete severance of the anterior aspect of the glenoidal labrum and rupture of the glenohumeral ligaments. Perfectly performed Nicola operations were observed to have failed when all anterior protection was lost. No doubt, in these cases, there were also large posterosuperior defects in the humeral head, but roentgenograms to bring out these defects seldom were taken.

Convalescent Care.—The average period of hospitalization varied in different hospitals from six to twelve weeks. Postoperatively, after all the corrective procedures, the arm was kept restricted to the side for approximately four weeks. Some surgeons, following Nicola's recommendation, started abduction exercises on the seventh day. Following Nicola operations, the elbow was not extended beyond 90 degrees for about four weeks. After Bankart and Magnuson operations, the elbow was often given free play, but the shoulder was routinely protected for four weeks against external rotation. Plaster of paris casts were seldom used. However, one orthopedist, who did the Robert's modification of the Nicola operation, routinely used a shoulder spica for four weeks.

Exercises: It became well established during the war that shoulder muscle exercises throughout convalescence hastened rehabilitation of the shoulder. Inside the restraining bandages or cast, the muscles were actively contracted against the bandages or cast or agonist was contracted against antagonist. Such exercises were carried out several times daily, and in some orthopedic sections they were carried out for five minutes every daylight hour. When the restraints were removed, the patients who had exercised their shoulders had better muscles and much wider ranges of motion than did those patients who failed to exercise.

Overcoming limitation of shoulder abduction and external rotation frequently required strenuous effort on the part of the patient. The various types of active motion, particularly resisted active motion, proved to be far more effective than passive stretching, with or without anesthesia. A few soldiers were not willing to expend the effort necessary to regain their shoulder motion, so that they had protracted periods of convalescence. Other soldiers were hypersensitive to pain and allowed their muscles to atrophy and their shoulders to become stiff, rather than experience the moderate pain that is inescapable in restoring joint motion after surgical intervention. In some cases, a psychologic problem underlay the resistance of the patient to rehabilitation.

Psychologic Problems Observed.—During the first part of the war, many shoulders were operated on for recurrent dislocations, irrespective of the patient's emotional maturity. The records show that several patients with a history of dislocations of the shoulder prior to military service who were operated on had a psychoneurosis. These patients

experienced severe neurotic symptoms postoperatively, and discharge from the service was often necessary.

Anxiety states and instances of conversion hysteria were observed in the series, but the commonest psychologic problem was psychogenic elaboration. The patients complained of pain in their operative scars and in their shoulder joints that far exceeded what could be accounted for on the basis of the physical observations. Atrophy of muscles was common in these patients, since shoulder exercises were avoided completely or carried out in a half-hearted manner. The secondary pains were so great that treatment was difficult and often unsuccessful.

During the latter part of the war, surgical treatment was deferred for all patients presenting a coexisting psychologic problem. Most Army Air Forces orthopedists became able to do their own psychologic evaluations.

Complications.—The following complications occurred: (*a*) pulmonary embolus following thrombophlebitis (1 case), (*b*) severe postoperative infection (1 case), (*c*) pneumonia (2 cases), (*d*) rheumatic fever (1 case) and (*e*) brachial neuritis (2 cases).

The patient in whom thromboplebitis developed died with the advent of a pulmonary embolus. While only one severe postoperative infection occurred, there were several instances of minor superficial infection, usually around sutures, which cleared up after a few days. Pneumonia was not severe in the 2 patients in whom it occurred, and both recovered. The rheumatic fever (1 case) developed on the sixth postoperative day. It was followed by recovery. No record was available to indicate the outcome in the 2 cases of brachial neuritis.

Results.—Studies of end results have been extremely difficult to obtain in the Army. This is due to the fact that during war soldiers remain at one installation only a relatively short time. Several follow-up procedures have been attempted, but thus far none has proved satisfactory.

Although the exact figures cannot be presented, there were approximately 20 per cent failures among patients who underwent the Nicola operation. Failure in most of these patients did not appear the first few weeks. Stanek and Andre [8] reported thirty-one Nicola operations performed at Camp Crowder, with only one failure, but their follow-up was only for the relatively brief period that their patients were assigned to Camp Crowder. In most cases failure resulted from strenuous work or sports. Sedentary workers achieved good results from their Nicola operations.

---

8. Stanek, W. F., and Andre, H. C.: The Nicola Procedure for Recurrent Dislocations of the Shoulder: Experiences at a Station Hospital, Mil. Surgeon **95**:402, 1944.

Kunz [9] (a former assistant of Nicola) stated that the rate of recurrence in competent hands should not exceed 5 per cent. He then stated that the operation had fallen into disfavor in the Army Air Forces Medical Corps because of a higher rate of recurrence. Kunz did not mention Nicola's latest recommendation that the capsule be explored and repaired in addition to redirection of the biceps tendon.

No record of failure of a Bankart or a Magnuson operation was found. However, study of end results at a later date will be necessary for an accurate estimation of the final results.

UNUNITED FRACTURES OF THE CARPAL SCAPHOID

Orthopedic surgeons entering the military service in 1941 and 1942 were surprised to see such large numbers of fractures of the carpal scaphoid and such a relatively few cases of Colles' fracture. In the larger training centers, with their emphasis on the major sports and rugged obstacle courses, a fracture of the carpal scaphoid was an almost daily occurrence. Medical officers became "scaphoid conscious" and obtained roentgenograms of nearly all "sprained wrists."

In most hospitals, scaphoid fractures were promptly diagnosed and properly immobilized and the incidence of nonunion was remarkably low. At other hospitals, the diagnosis was delayed, casts were allowed to become loose and frequently immobilization was discontinued too soon, with the result that ununited scaphoid fractures became common.

Prior to the war there was a widespread belief that these fractures failed to heal in a high percentage of cases for anatomic reasons. However, from the Army experience, it now appears that the real reasons for the high incidence of nonunion in civilian practice is the frequent delay in diagnosis and inadequate, insufficiently prolonged immobilization. Nonunion on the basis of an impaired blood supply,[10] absence of periosteal callus[11] and bathing of the fracture site by synovial fluid appear to be the exception and not the rule.

The 63 cases of fracture herein reviewed were collected from Army Air Forces regional hospitals in the United States. A qualified orthopedic surgeon was in charge of the orthopedic section in each of the regional hospitals. However, many of the patients in this series were transferred to regional hospitals from small station hospitals, where there was no orthopedist. Simple fractures of the carpal scaphoid generally were treated in the station hospitals. If there was nonunion

9. Kunz, H. G.: Nicola Operation, Mil. Surgeon **96**:429, 1945

10. Obletz, B. E., and Halbstein, B. M.: Non-Union of the Carpal Navicular, J. Bone & Joint Surg. **20**:424, 1938.

11. Johnson, R. W., Jr.: A Study of the Healing Process in Injuries of the Carpal Scaphoid, J. Bone & Joint Surg. **9**:482, 1927.

or aseptic necrosis, the patient was then referred to a regional or a general hospital.

The average age of the soldiers in this series was 26 years; the youngest was 20, and the oldest was 44.

Forty-four, or 70 per cent, of the fractures occurred in line of duty, whereas nineteen, or 30 per cent, had existed prior to the soldier's military service.

The shortest duration preoperatively was nine weeks and the longest was eight years.

Causes of Nonunion.—Inadequate protection of the fracture fragments caused most of the scaphoid nonunion in this series. The faulty immobilization stemmed from several errors. Failure to diagnose the fracture headed the list of errors in the cases in which fracture had existed prior to military service. The fractures were diagnosed as sprains and given no period of immobilization. Since fractures of the scaphoid do not heal without immobilization, nonunion naturally resulted.

TABLE 3.—*Duration of the Fracture Prior to Operation*

Duration	Number of Cases	Percentage of Cases
4 mo. or less	10	15.8
4 to 6 mo.	7	11.1
6 to 12 mo.	13	20.5
1 to 2 yr.	8	12.6
2 yr. or longer	25	40.0
Total	63	100.0

Among cases in which the fracture had occurred in the line of duty, there were relatively fewer instances of failure to diagnose the fracture. However, inadequate immobilization was common and resulted both from casts becoming loose and from removal of the cast prior to bony union. In numerous instances immobilization was discontinued at the end of six or eight weeks in the presence of incomplete healing. The routine abandonment of the cast at the end of a given period (usually six to eight weeks) proved to be a costly error.

Many casts were applied while there was considerable swelling in the wrist and the hand. After a few days, edema would subside and the cast would become loose. Unfortunately, a large number of such casts were allowed to remain on for six weeks or more, and all the while the patient was urged to exercise his wrist and fingers. With so many shearing stresses, it is not surprising that the incidence of nonunion was higher than it should have been. In hospitals in which strict attention was given to early diagnosis and uninterrupted effective immobilization, better than 95 per cent of scaphoid fractures united by sound bony callus.

Prior to the war it was contended that aseptic necrosis of the proximal fragment prevented bony union. In this series many instances of delayed healing from aseptic necrosis were seen and several instances of nonunion, but there were also many instances in which normal bony union occurred, the necrotic fragment regenerated and a normal or near-normal range of painless motion restored to the wrist. Evidence from this study indicates that the routine excision of the proximal fragment in the presence of aseptic necrosis is not justified.

Pronounced displacement of the fragments in fractures of the carpal scaphoid is exceptional, but when it occurs it usually leads to nonunion. Failure to heal results from the fact that such fractures can rarely be reduced only by closed methods, and persistent displacement is incompatible with bony union. The incidence of fractures of this type was between 3 and 5 per cent. An immediate open reduction is indicated, but generally was not done.

Indications for Surgical Treatment.—Surgical intervention is not indicated in all cases of nonunion. This was borne out by the cases in which the patient had had an ununited carpal scaphoid fracture for many years, yet had continued to do heavy work without significant disability. No record was kept of the total number of such patients seen, but it was decidedly high. Many of these patients were seen at the end of the war, after the soldier had performed full and strenuous military duties throughout the war. In the roentgenograms of this group, there were numerous instances in which there appeared to be an efficiently functioning nearthrosis. Clearcut smooth articular cortices had formed, and more often than not no reactive osteoarthritic changes were detectable in roentgenograms.

Early in the war, bone grafts were performed on old cases of nonunion of the carpal scaphoid in the hope of qualifying the soldier for full military duty. In the Army Air Forces it was done to make the soldier eligible for air crew training. This policy was later abandoned. Few soldiers were qualified for full duty through surgical treatment, and not a small number experienced more disability after the operation than before. In 1 case there were bilateral ununited scaphoids. The one on the left was incurred in line of duty, and a peg graft was inserted. In the result recorded, after one year of hospitalization, the left wrist had 45 degrees of flexion and 20 degrees of extension, whereas, the opposite wrist, on which operation had not been performed, had 80 degrees of flexion and 80 degrees of extension. Furthermore, the left wrist was painful and the right practically painless.

In the cases in which the disability had been incurred in the line of duty, some type of operative procedure was carried out whenever the disability warranted and when the soldier desired the operation.

During the latter part of the war a psychologic evaluation was made preoperatively in all cases. In the early part of the war this was not always done, and, as a result, several surgeons operated on patients that should have had only conservative treatment.

There was little agreement among the Army Air Forces orthopedists regarding the treatment of the ununited scaphoid fracture. Surgeons with the most experience were, as a group, discouraged about their low percentage of good results from surgical treatment.

Comments on the Various Operative Procedures.—1. Drilling of the Fragments: Blind drilling proved inaccurate and generally unsuccessful. In the 6 cases in this series there was drilling by open operation. In 3 of these cases nonunion was not seen at operation. The roentgenograms showed what appeared to be a definite fracture line, but at the operation no pseudoarthrosis could be identified. Several small drill holes were made across the fracture line as planned and the wounds closed.

TABLE 4.—*Operative Technics*

Procedure	Number of Cases	Percentage of Cases
Drilling of fragments	6	9.5
Cortical bone grafts (pegs and inlays)	34	54.0
Cancellous bone grafts (packing)	9	14.3
Excision proximal fragment	8	12.6
Excision entire scaphoid	2	3.2
Radiocarpal arthrodesis	4	6.4
Total	63	100.0

When there was clearcut nonunion, multiple drill holes appeared worth while, but most of the orthopedists interviewed contended that the operative procedure should also include some type of bone graft.

2. Cortical Bone Grafts: During the early part of the war the peg graft was almost universally employed. It was inserted one of three ways: (1) by drilling a hole through both fragments, starting at the scaphoid tubercle, (2) by drilling a hole across the fracture line from a dorsal approach and (3) by preparing a bed in the dorsum of the scaphoid and inlaying the peg graft.

By the end of the war the peg graft had lost much of its former prestige. The incidence of failure of bony union was not alarmingly high, but the percentage of wrists in which a good range of painless motion was restored was low, much lower, in fact, than many surgeons were willing to admit.

The peg grafts used early in the war tended to be small and were referred to as match grafts. Larger grafts later replaced the tiny match grafts, but the results did not materially improve.

Few technical difficulties were mentioned. In blind pegging, the check roentgenograms occasionally brought surprises as to the location of the graft. In 1 case the peg lay between the lunate and the proximal pole of the scaphoid. Wide exposure for drilling by direct vision or for the preparation of a bed for an inlay graft had the disadvantage of jeopardizing the blood supply to the scaphoid.

3. Cancellous Bone Grafts: Grafts of cancellous bone were used in two forms: (1) The graft was removed in one piece, usually from the ilium, and employed as an inlay or inserted into a channel across the fracture line, and (2) multiple small cancellous chips and spicules were removed from the radius, ilium or upper part of the tibia and packed into cavities made by curetting out much of the interior of the fracture fragments. Milgram [12] suggested this technic after obtaining good results from its use. In the Army Air Forces Regional Hospital at Coral Gables, Fla., this technic was used in 6 cases and proved to be reasonably satisfactory. It is best adapted to cases in which the fracture line is through the waist of the scaphoid. A small proximal fragment does not lend itself to this type of graft.

4. Excision of the Proximal Fragment: Several orthopedic surgeons expressed the belief that when the proximal fragment was small or showed evidence of aseptic necrosis its early removal offered the best opportunity for a good result. That this technic was not often followed is indicated by the fact that it was used in only 12.6 per cent of the cases. However, at the end of the war there was a considerable number of surgeons who stated the belief that this procedure has a wider application than it has been given in the past.

5. Excision of the Entire Scaphoid: This procedure was not believed to be justified. In 1 of the 2 cases in this series in which it was performed, it was done because of advanced osteoarthritic changes. In the other case the scaphoid was removed by error. The operator (not an orthopedic surgeon) had intended removing the lunate for disabling chronic osteitis (Kienbock's disease).

6. Radiocarpal Arthrodesis: The 4 patients for whom arthrodesis was resorted to had advanced osteoarthritic changes and severe disability. In 2 of the 4 patients a scaphoid bone graft had failed to give either a bony union or relief from pain. Both the radiocarpal and the midcarpal rows were fused. In 1 patient the bone graft extended to the base of the third metacarpal. In all cases there was good bony fusion with relief from pain. The radioulnar joint was preserved, and, therefore, pronation and supination were not lost.

Pathologic Changes.—The changes encountered at the site of nonunion depended, for the most part, on the duration of the fracture.

12. Milgram, J. E.: Personal communication to the authors.

In cases of nonunion of short duration there was interposed cellular fibrous tissue. The bone was porotic and hyperemic in the viable fragments. When there was aseptic necrosis of the proximal pole it was the rule to observe regeneration for at least a millimeter or so at the fracture surface. Changes in the joint capsule were not advanced, but a moderate degree of fibrocystic hyperplasia and edema were present in the vicinity of the fracture site. Adhesions between the synovia and the fracture line generally were more numerous when there was aseptic necrosis of the proximal fragment. No doubt the adhesions were formed in part to carry new blood vessels to the necrotic bone.

In cases of nonunion of long duration there was either a dense fibrous union or a nearthrosis. In several cases in which considerable motion occurred at the fracture site, a new joint had formed in which there were fairly well developed articular surfaces of hyaline tissue and fibrocartilage. Osteosclerosis of the fracture surfaces characterized long-standing nonunion. Because of some bone absorption at the fracture site, the fragments seldom fitted together accurately at the periphery.

Reactive osteoarthritic changes varied from a minimal narrow margin of degeneration on each side of the fracture line to advanced changes in the articular cartilage of both the scaphoid and the radius. In 3 of the 4 cases in which radiocarpal arthrodesis was required, there were advanced traumatic osteoarthritic changes in the form of pale yellowish discoloration of the cartilage, fibrillation and areas of erosion.

Joint capsules varied widely in thickness, but generally were thick and fibrotic. Synovial hyperplasia with villous formation were uncommon.

Complications.—The following complications occurred:

1. One moderately severe postoperative infection developed in a 20 year old soldier with an ununited fracture of the scaphoid of two years' duration. A peg graft had been inserted. When the infection was controlled two months later, the bone graft and the proximal fragment of the scaphoid were removed. A severely painful wrist resulted, so that a radiocarpal fusion was performed and a useful painless wrist was ultimately the outcome.

2. Two patients experienced anxiety states postoperatively, which subsided under psychotherapy.

Results.—Table 5 gives the end results, based on the range of motion, the presence of pain and the state of union.

End results were, of necessity, often tabulated after only a few months of follow-up. The chances are good, however, that a long range study of end results will show somewhat better results than are indicated in table 5. Many soldiers have less symptoms after they are discharged

from the service and are reestablished in civilian life. Secondary gains then cease to be a factor, except in those instances in which disability must be perpetuated in order to maintain a veteran's pension at its original level.

Good motivation played an important part in securing good end results, and, conversely, poor motivation prevented many patients from realizing full function of their wrists. An ununited fracture and poor motivation proved to be a difficult combination from which to resolve a good result.

The results from cancellous bone grafts appeared to be superior to those from cortical grafts, but, since there were relatively few cancellous grafts employed in this series, these two types of bone grafts cannot be accurately compared.

TABLE 5.—*Results of Surgical Treatment*

Result	Number of Cases	Percentage of Cases
Good	31	49.2
Fair (improved)	12	19.0
Poor (no improvement)	20	31.8
Total	63	100.0

It was the consensus that total excision of the scaphoid was not a good operation, and there were no supporters of Brittain's [13] procedure of excising the entire proximal row of carpals.

The procedure of excision of fragments, it was felt, should be limited to excision of the proximal pole. In this technic, results were best when the proximal fragment was small and the operation performed within the first few weeks after the fracture.

The results from the radiocarpal fusions were good in the sense that the patients became free from pain; but the price paid for freedom from pain was sacrifice of flexion and extension.

Since nearly all fractures of the carpal scaphoid heal when treated early and properly, it was a universal conviction that the best way to handle the still unsatisfactorily solved problem of the ununited carpal scaphoid is to prevent them.

13. Brittain, H. A.: Fractures of the Carpal Scaphoid, Brit. M. J. **2**:671, 1938.

CHEMOSURGICAL TREATMENT OF CANCER OF THE EXTREMITIES AND TRUNK

A Microscopically Controlled Method of Excision

FREDERIC E. MOHS, M.D.
MADISON, WIS.

SYSTEMATIC microscopic control of excision is the chief advantage of the chemosurgical method of cancer treatment. This control makes possible, in effect, the selective destruction and removal of cancer tissue with the consequent dual advantages of reliability and conservatism.

The method is limited to the treatment of neoplasms in regions of the body sufficiently accessible for the use of a stage by stage procedure. The development and general applications of the method have been described,[1] as has its use in the treatment of cancer of the lip,[2] nose,[3] ear,[4] eyelid,[5] face,[6] and skin.[7] The present article concerns the technic used and the therapeutic results obtained in the treatment of cancer of the extremities and trunk.

This project was aided by the Thomas E. Brittingham Fund, the Wisconsin Alumni Research Foundation and the Jonathan Bowman Memorial Fund.

From the Department of Surgery, Dr. E. R. Schmidt, Chief, State of Wisconsin General Hospital, and the McArdle Memorial Laboratory for Cancer Research.

1. Mohs, F. E., and Guyer, M. F.: Pre-Excisional Fixation of Tissues in the Treatment of Cancer in Rats, Cancer Research **1**:49 (Jan.) 1941. Mohs, F. E.: Chemosurgery: A Microscopically Controlled Method of Cancer Excision, Arch. Surg. **42**:279 (Feb.) 1941.

2. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Lip: A Microscopically Controlled Method of Excision, Arch. Surg. **48**:478 (June) 1944.

3. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Nose: A Microscopically Controlled Method, Arch. Surg. **53**:327 (Sept.) 1946.

4. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Ear: A Microscopically Controlled Method of Excision, Surgery **21**:622 (May) 1947.

5. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Eyelid: A Microscopically Controlled Method of Excision, Arch. Ophth. **39**:43 (Jan.) 1948.

6. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Face: A Microscopically Controlled Method of Excision, Arch. Dermat. & Syph. **56**:143 (Aug.) 1947.

7. Mohs, F. E.: Chemosurgical Treatment of Cancer of Skin: A Microscopically Controlled Method of Excision, J. A. M. A. **138**:564 (Oct. 23) 1948.

TECHNIC

The chemosurgical technic will be described by means of the report of a case of cancer of the thumb. The patient, a dentist, for thirty-five years had made a practice of holding dental films in the mouths of his patients. Scaliness of the thumb and fingers had been present for ten years and definite keratosis for three years, but the patient was not aware that these were the sequelae of roentgen irradiation. On the tip of the right thumb was a growth of one year's duration. It was 15 mm. in diameter and was ulcerated in the center (fig. 1 *A*).

Following the administration of 0.03 Gm. of codeine phosphate and 0.65 Gm. of acetylsalicylic acid, the first step was the application of dichloroacetic acid to the portion of the growth that was covered with skin. The purpose of this keratolytic chemical was to render the layer of keratin permeable to zinc chloride. Then the zinc chloride fixative, Z-108a,[8] was applied in a thickness of about 0.5 mm. This material was covered with a thin layer of cotton, over which was placed an overlapping cotton dressing spread with petrolatum. The dressing was firmly fastened with adhesive tape. Analgesics were prescribed, with instructions to take them as often as every three hours, as needed.

Fig. 1.—*A*, squamous cell carcinoma, 15 mm. in diameter, which had arisen on the end of the thumb of a dentist who had used this thumb to hold dental x-ray films in place. *B*, granulation tissue after separation of final layer of fixed tissue. The fixed bone of the end of the distal phalanx is still adherent. *C*, healed lesion. There was no recurrence of the cancer after seven years.

After twenty-four hours there was sufficient penetration of the fixative to allow the excision of a layer of fixed tissue 3 mm. in thickness. The incision was made through tissue which had been killed and fixed, so there was no pain or bleeding from this operation. Since it was impossible to tell by gross inspection whether or not carcinoma was present at this level, the entire area was subjected to microscopic examination. This was done by dividing the excised layer into two specimens and cutting frozen sections through the under surface of each. Microscopic examination of these sections revealed the entire area to be cancerous; this observation was recorded on a map of the lesion (fig. 2 *A*). The microscopic diagnosis was squamous cell carcinoma with a grade of malignancy of 1. Fixative was reapplied to the entire surface exposed by the first excision.

On the next day, a layer 2 mm. thick was excised and subjected to systematic microscopic examination. By this means, the cancer at this level was observed

8. This fixative paste contains 40 Gm. of stibnite (80 mesh sieve), 10 Gm. of powdered sanguinaria and 34.5 cc. of a saturated solution of zinc chloride.

to be localized in three areas adjacent to the tip of the distal phalanx (fig. 2 *B*). Reapplication of the fixative, it is important to note, was limited to the cancerous areas.

On the following day, the treated area was demonstrated to be free of cancer (fig. 2 *C*). The tip of the distal phalanx, which had been surrounded by cancer, was clipped off with a rongeur. The specimen was decalcified and paraffin sections were made; these demonstrated the absence of involvement of the bone. The lesion was covered with two layers of petroleum gauze and a cotton and gauze dressing.

One week later, the thin, final layer of fixed tissue had loosened; it was readily removed by clipping the holding fibrous strands with a sharp-pointed scissors, revealing healthy granulation tissue (fig. 1 *B*). Another week was required for the final layer of fixed bone to become sufficiently demarcated so that it could be grasped with a rongeur and removed by means of a rocking motion, leaving a bleeding surface which soon became covered with granulation tissue. The lesion healed rapidly, with the formation of a soft, smooth, pliable scar (fig. 1 *C*). As a result of the conservative approach, made possible by the chemosurgical method, the function of the thumb was well preserved. The patient was able to continue

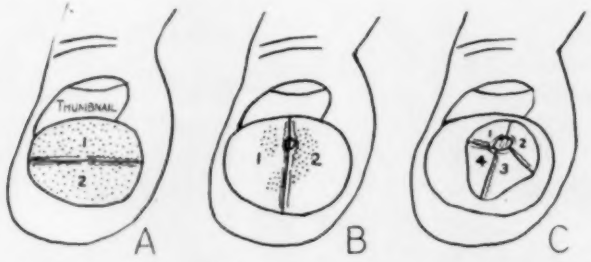

Fig. 2.—Maps showing location of specimens removed on successive days from the lesion pictured in figure 1. The straight and wavy lines at the edges of the specimens indicate that these edges were marked with merbromin and india ink, respectively, for purposes of orientation. Stippled areas represent cancer located by microscopic examination of frozen sections, made through the under surface of each specimen. The cross hatched areas in *B* and *C* represent the tip of the phalangeal bone.

his dental practice, and even the sport of bowling. There was no recurrence after seven years.

The lesion in this case was a relatively early and well delimited carcinoma. Some less delimited neoplasms, however, may send out slender, clinically undetectable outgrowths several centimeters beyond the visible and palpable portion of the tumor. For example, a carcinoma of the index finger produced by exposure to roentgen rays exhibited slender extensions nearly 4 cm. proximal to the small periungual ulcer, which was the only clinical manifestation of the carcinoma. Since it is impossible to determine the exact extent of a cancer by clinical examination, the value of microscopically controlled dissection is evident.

Usually cancerous involvement of bone is grossly detectable. However, a recently treated cancer of the thumb recurred because of residual

carcinoma in the proximal end of the phalangeal bone. Therefore, the safest course is to save the final layer of fixed bone for decalcification and paraffin sections.

The chemosurgical excision of cancer tissue which surrounds a tendon may entail the chemical fixation of the tendinous tissue. This circumstance, however, does not necessarily require the removal of the tendon. If the tendon is left in place, granulation tissue and epithelium will often cover the structure, with resultant preservation of its function. Whether the chemically killed tendon is replaced is not known; at any rate, such structures have been observed to function for several years, without evidence of foreign body reaction. The hand may often be preserved in spite of rather extensive involvement of the tendons and bone (fig. 6). The remaining structures are held in place by the firm scar, and much useful function may be preserved.

If, in the treatment of cancer of the end of a finger or of a toe, a cancer-free plane is reached at the level of an interphalangeal joint, it is advisable to carry fixation into the body of the phalangeal bone rather than leave the surface of the joint exposed. Otherwise, the poorly vascularized articular cartilage prevents healing.

The scars produced by the chemosurgical removal of neoplasms from the weight-bearing surfaces of the foot (fig. 7) do not produce as great a handicap as was expected. There may be some hyperkeratosis and discomfort in walking long distances, but the discomfort can be reduced by use of pads to shift the weight to intact portions of the foot. The scars do not break down.

Serious hemorrhage in the course of chemosurgical treatment of cancer of the extremities and trunk is not apt to occur, except in the axillary and inguinal regions. When one is working around large vessels, it is advisable to place a suture ligature around the vessels as they are exposed. If bleeding occurs from vessels smaller than the radial artery during excision of layers of fixed tissue, prompt hemostasis may be obtained by the application of a small square of fixative-impregnated gauze under momentary pressure.

In the treatment of the large but very superficial basal cell carcinomas sometimes seen on the trunk it may be unnecessary to subject the entire area to microscopic examination. In such cases it is often sufficient to section only the periphery. In all other cases it is essential that the entire area under treatment be sectioned until a plane completely free of cancer is reached.

For the extremities and the trunk, except the back, the average time required for the final layer of fixed tissue to become sufficiently demarcated so that it may be dissected off is from seven to eight days. The thick dermis of the skin of the back causes separation to be delayed for about ten days.

THERAPEUTIC RESULTS IN CASES OF SQUAMOUS CELL CARCINOMA OF THE EXTREMITIES AND TRUNK

Squamous cell carcinomas of the extremities and trunk were chemosurgically treated in a total of 51 cases during the seven and one-half years ending Jan. 25, 1944, which date is over three years prior to the time of writing. The lesions were in all stages, from early to far advanced; some had metastasized. In nearly one-half the cases previous, unsuccessful surgical or radiation treatment had been received.

End Results After Three Years or More.—The 51 cases were divided into two groups, the indeterminate and the determinate, according to the plan of Martin, MacComb and Blady.[9] The indeterminate group

TABLE 1.—*End Results for Squamous Cell Carcinoma of the Extremities and Trunk After Periods of Three and Five Years* *

	Three Year Period		Five Year Period	
Total number of patients		51		44
Indeterminate group				
Patients who died of other causes without recurrence	8		8	
Patients lost from observation without recurrence	1		1	
Total number		9		9
Determinate group				
Total number		42		35
Unsuccessful results				
Patients who died; cancer present at time of death	3		2	
Patient lost from observation with cancer	2		2	
Patients living with cancer	0		0	
Total number	5		4	
Successful results				
Patients free from cancer for three years or more		37		
Patients free from cancer for five years or more				31
Percentage of determinate cases with successful results		88.1		88.6

* This series includes all patients with histologically proved squamous cell carcinoma, both early and advanced, previously untreated and recurrent, with and without metastasis, who were admitted to the chemosurgical clinic from Aug. 9, 1936 to Jan. 25, 1944, for the three year group, and from Aug. 8, 1936 to May 5, 1942, for the five year group.

was composed of the 9 cases in which the patients either died of intercurrent disease or were lost from observation, but in which there was no known recurrence. The determinate group included the 5 cases in which treatment was known to be unsuccessful and the 37 cases in which it was successful. For the 42 cases in the determinate group the rate of cure after three years or more was 88.1 per cent (table 1).

End Results After Five Years or More.—There was a total of 44 cases in the five year period. Nine cases were in the indeterminate group and 35 in the determinate. For the 35 cases in the determinate group, the rate of cure after five years or more was 88.8 per cent (table 1).

9. Martin, H. E.; MacComb, W. S., and Blady, J. V.: Cancer of the Lip, Ann. Surg. **114**:341 (Sept.) 1941.

Effect of Size of Lesions on Prognosis.—The lesions were divided into four subgroups, according to their average diameter: *A*, under 1 cm.; *B*, 1 to 2 cm. (fig. 1); *C*, 2 to 3 cm. (fig. 3), and *D*, over 3 cm. (figs. 4 to 8, inclusive).

The end results after a period of three years or more showed that there was only 1 failure in subgroups *A*, *B* and *C*, while there were 4

Fig. 3.—*A*, squamous cell carcinomas of the index and middle fingers, and keratosis of the ring finger of a physician who had been repeatedly exposed to a diagnostic x-ray machine about twenty-five years before. *B*, granulation tissue after chemosurgical excision in six microscopically controlled stages and after removal of the final layer of fixed tissue. *C*, healed lesions. No cancer was evident after four years.

in subgroup *D* (table 2). However, the failures were, with 1 exception, due, not to failure to eradicate the primary lesion, but to failure to control metastasis. The 1 failure to remove the primary lesion chemosurgically occurred when an advanced carcinoma of the

dorsum of the hand was found to have eroded through to the palmar surface; chemosurgical treatment was discontinued, and the hand was surgically amputated (with no recurrence of the neoplasm).

Therefore, almost all primary lesions, regardless of size, can be successfully eradicated with the chemosurgical technic, but the prognosis is definitely worse when the lesion has become extensive, owing to the associated increased incidence of metastasis.

Effect of Previous Treatment on Prognosis.—Twenty (47.6 per cent) of the 42 squamous cell carcinomas in the determinate group were lesions which had recurred after previous surgical, caustic or radiation treatment, given either alone or in combination. Chemosurgical treatment made it possible to eradicate 75 per cent of these recurrent lesions,

TABLE 2.—*Effect of Size of Squamous Cell Carcinoma on Prognosis*

Group	Average Diameter, Cm.	Number of Lesions	Successful Results	
			Number	Per Cent
A	Under 1	1	1	100.0
B	1-2	15	14	93.3
C	2-3	8	8	100.0
D	3 or more	18	14	77.7
All groups		42	37	88.1

TABLE 3.—*Effect of Previous Treatment of Squamous Cell Carcinoma on Prognosis*

	Number of Patients	Successful Results	
		Number	Per Cent
Previously treated	20	15	75
Previously untreated	22	22	100

but this rate of cure falls far below the 100 per cent attained in the treatment of carcinomas which had not previously been treated (table 3).

However, it should be pointed out that the circumstance of recurrence does not in itself constitute a poor prognostic factor. Rather, it is the delay and trauma of the neoplasm that favor the occurrence of metastasis, which, in turn, is a highly unfavorable complication.

Effect of Histologic Grade of Malignancy on Prognosis.—There is a definite correlation between the degree of malignancy of the lesion as expressed by means of Broders' classification, and the percentage of successful results (table 4). However, the primary lesion was eradicated in all but 1 case, regardless of the grade of malignancy. Therefore, the poorer prognosis associated with higher grades of malignancy is occasioned, to a large extent, by the greater tendency to metastatic spread from such lesions.

Effect of Site of Cancer on Prognosis.—The rate of cure of squamous cell carcinoma of the trunk and extremities was 100 per cent for all sites except the hand and the foot (table 5). It is probable that the

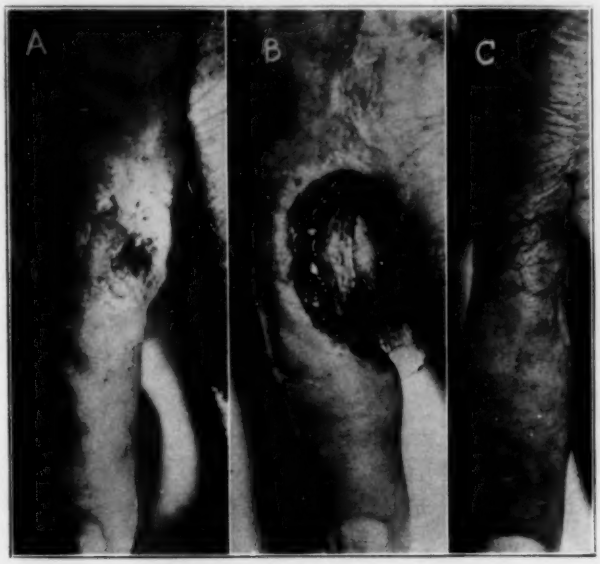

Fig. 4.—*A*, squamous cell carcinoma with deep invasion of the base of the index finger. *B*, granulation tissue after chemosurgical excision in seven microscopically controlled stages and after removal of the final layer of fixed tissue. *C*, healed lesion. The patient was free of cancer after six years.

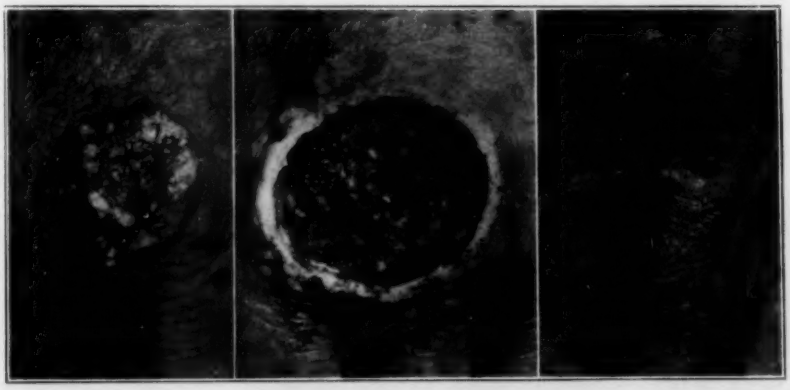

Fig. 5.—*A*, squamous cell carcinoma which had recurred after two surgical excisions. *B*, granulation tissue after chemosurgical excision in three microscopically controlled stages and after removal of the final layer of fixed tissue. *C*, healed lesion. There was no recurrence of the cancer after five years.

increased chance for metastatic dissemination in these sites, as a result of motion and trauma, is the main reason for the associated poorer prognosis.

In the present series, no vital structures were involved by the carcinomas. However, if an abdominal lesion penetrated the peritoneum or a lesion of the chest involved the pleura, or if an axillary or inguinal lesion involved the large vessels in the axilla or the groin, it is obvious that the prognosis would be poor.

Effect of Metastasis on Prognosis.—The presence or absence of metastasis is of utmost importance in the determination of prognosis in

TABLE 4.—*Effect of Histologic Grade of Malignancy of Squamous Cell Carcinoma on Prognosis*

Grade	Number of Lesions	Successful Results	
		Number	Per Cent
1	16	16	100.0
2	17	15	88.2
3	9	6	66.6
4	0	0	....

TABLE 5.—*Effect of Site of Origin of Squamous Cell Carcinoma on Prognosis*

Site	Number of Lesions	Successful Results	
		Number	Per Cent
Finger	7	7	100.0
Hand	22	18	81.8
Arm	2	2	100.0
Toe	1	1	100.0
Foot	2	1	50.0
Leg	4	4	100.0
Trunk	4	4	100.0

TABLE 6.—*Effect of Metastasis on Prognosis*

	Number of Patients	Successful Results	
		Number	Per Cent
Without metastasis	37	36	97.3
With metastasis	5	1	20.0

cases of squamous cell carcinoma of the extremities and trunk. Thus, in the absence of metastasis successful results were attained in 97.3 per cent of the cases, while in the presence of metastasis the rate of cure was only 20 per cent (table 6).

In the absence of metastasis the only failure was in a case in which the patient's hand was completely penetrated by a carcinoma. Surgical amputation of the hand was resorted to, with a successful outcome.

In 4 of the 5 cases in the determinate group in which metastasis was present, axillary or inguinal dissections were carried out by Dr.

Fig. 6.—*A*, squamous cell carcinoma with deep invasion of the dorsum of the hand. The lesion had recurred after the application of caustics and after repeated radium treatments. *B*, granulation tissue after chemosurgical removal in fifteen microscopically controlled stages. The carcinoma was observed to erode the second and third metacarpal bones, which were largely removed. *C*, healed lesion. The scar held the remaining structures of the hand firmly together, with the result that the function of grasping was preserved. The patient was able to handle his garden tools as well as ever. There was no cancer present when he died of other causes, after five years.

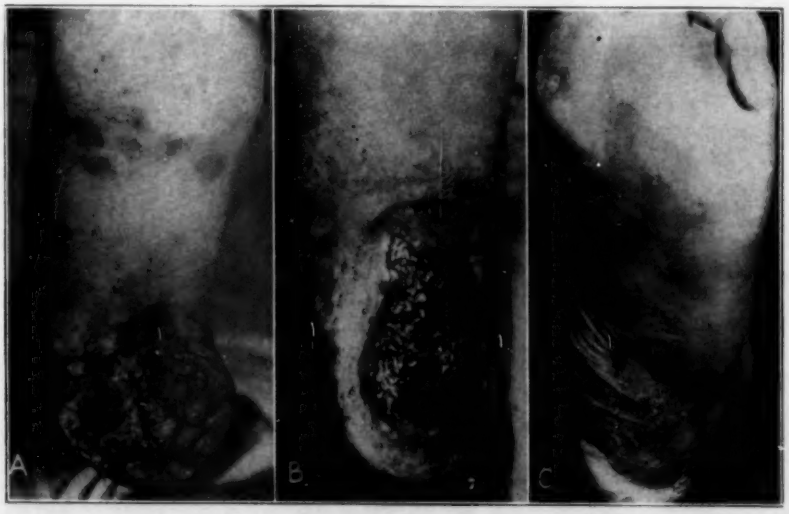

Fig. 7.—*A*, squamous cell carcinoma of the heel. The lesion had been excised on several occasions by means of electrocautery. *B*, granulation tissue after chemosurgical excision in eleven microscopically controlled stages. *C*, healed lesion. The patient was able to walk on the foot without difficulty. A small metastatic inguinal node was surgically resected. The was no recurrence of the cancer when the patient died of other causes, after five years.

Fig. 8.—*A*, squamous cell carcinoma of the lower leg. *B*, granulation tissue after chemosurgical excision in four microscopically controlled stages, and after removal of the final layer of fixed tissue. *C*, healed lesion. There is no recurrence of the cancer after more than four years.

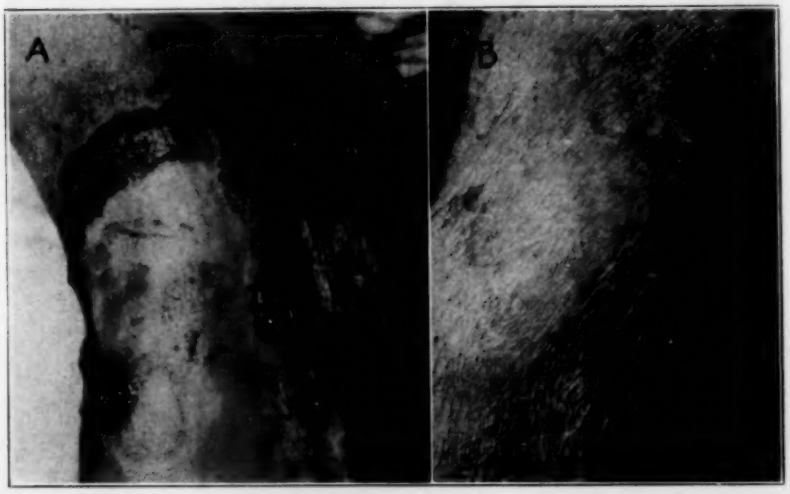

Fig. 9.—*A*, basal cell carcinoma over the elbow. The lesion had recurred in this serpiginous manner after a number of treatments with electrodessication and caustics. *B*, healed lesion after chemosurgical excision. The patient was free of cancer after five years.

E. R. Schmidt and his staff; a five year cure resulted in the 1 case in which the nodes were small. In another case, a patient with axillary metastasis was apparently cured by means of a resection of the shoulder girdle by Dr. K. E. Lemmer; but since the patient died of other causes after two years, this case cannot be classified with those having a successful outcome.

The difficulty in eradicating metastatic lesions in the axilla and groin is the chief reason that the presence or absence of metastasis is the most important prognostic factor.

THERAPEUTIC RESULTS IN CASES OF BASAL CELL CARCINOMA OF THE EXTREMITIES AND TRUNK

There were 16 cases of basal cell carcinoma in the three year period and 10 in the five year period. Three cases were classified as indeterminate in each group; hence, there were 13 and 7 determinate

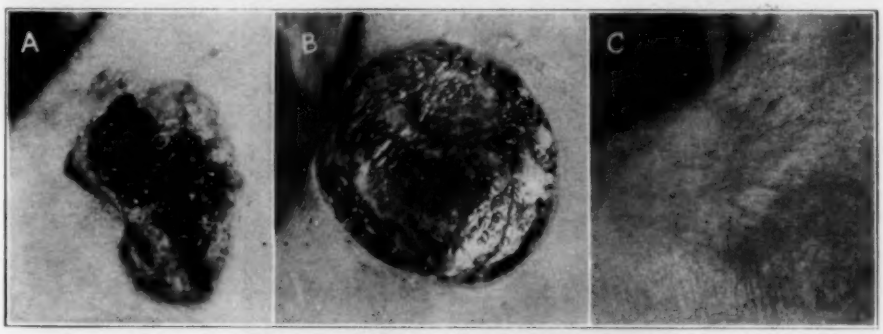

Fig. 10.—*A*, basal cell carcinoma over the trapezius muscle. *B*, granulation tissue following chemosurgical excision in four microscopically controlled stages, and after removal of the final layer of fixed tissue. *C*, healed lesion. The patient was free of cancer after six years.

TABLE 7.—*Distribution of Basal Cell Carcinoma According to Size*

Group	Average Diameter, Cm.	Number of Lesions
A	Under 1	1
B	1-2	2
C	2-3	5
D	3 or more	5

cases in the three year and five year periods, respectively. There were no failures in these determinate cases. In other words, the rate of cure for basal cell carcinoma in both the three year and the five year period was 100 per cent.

Most of the basal cell carcinomas were in the larger size subgroups (table 7). Examples are shown in figures 9, 10 and 11. Previous,

unsuccessful treatment had been received in 4 (30 per cent) of the 13 cases in the three year period. Histologically, the carcinomas were classified as "invasive" in 6 cases and "noninvasive" in 7 cases. Ten of the lesions involved the trunk, while the hand, arm and leg were each involved by the lesion in 1 case.

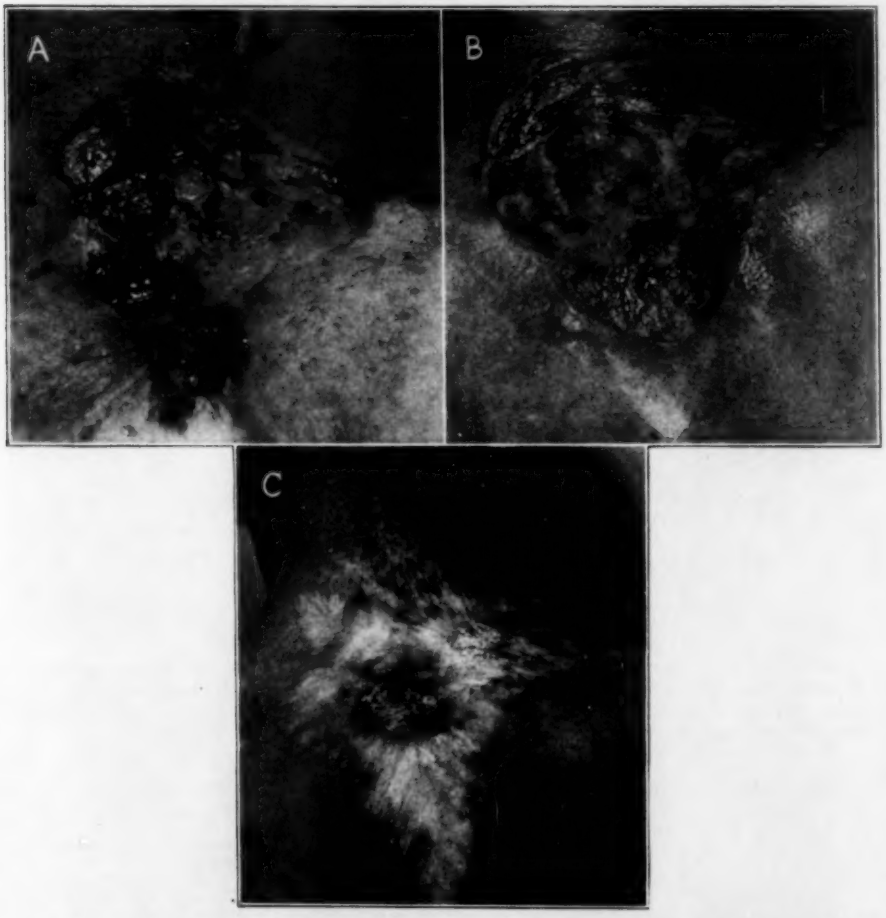

Fig. 11.—*A*, basal cell carcinoma in the posterior nuchal and scapular regions. The lesion had repeatedly recurred after numerous surgical excisions and roentgen treatments over a period of thirty years. *B*, granulation tissue after chemosurgical excision in ten microscopically controlled stages, and after removal of the final layer of fixed tissue. *C*, healed lesion. The depigmented, atrophic type of scar is due to the large amount of roentgen radiation which had been administered in the years prior to chemosurgical excision. The patient was free of cancer after five and one-half years.

COMMENT

The advantages of chemosurgical treatment of cancer of the extremities include reliability, conservatism and essential absence of operative mortality.

The unprecedented reliability is made possible by the systematic microscopic control of excision, by which each silent outgrowth from the main cancerous mass may be accurately followed out and eradicated. These outgrowths often follow devious paths which are completely unpredictable by clinical examination.

The results of the method compare favorably with those reported by Magnussen,[10] whose series is significant from both a statistical and a therapeutic standpoint. Thus, the results of his treatment of squamous cell carcinoma, as computed from his protocols, indicate that the rate of cure for 17 determinate cases for the three year period was 63.6 per cent. For 42 determinate cases in the present series, the rate of cure was 88.1 per cent. It should be stated, however, that in more of his cases than in the present series the lesions were in the two larger size subgroups (87.5 per cent, as compared with 61.9 per cent). However, in his series fewer lesions had recurred after previous treatment than in this series (20 per cent, as compared with 47.6 per cent).

Similarly, in a series of 11 cases of basal cell carcinoma of the extremities and trunk, Magnussen reported a rate of cure of 91 per cent, while in the present series, of 13 cases, the rate was 100 per cent. The record in the latter series was attained despite a larger proportion of lesions in the large size subgroups (77 per cent, as compared with 63.6 per cent) and despite a larger proportion of cases in which previous treatment had been received (30 per cent, as compared with 27.3 per cent).

The great reliability of chemosurgical treatment is not attained at the expense of unnecessarily radical excision. On the contrary, only 1 or 2 mm. beyond the limits of cancerous invasion is destroyed. Thus, in effect, the method affords a selective means of destroying cancer tissue. This conservatism is particularly valuable in the treatment of cancer of the fingers and hands because the preservation of these structures is very important from an economic standpoint. Cases in point are those of a dentist (fig. 1), a doctor (fig. 3) and two farmers (figs. 5 and 6).

The practically complete absence of operative mortality is an important advantage because many patients with cancer are old and in poor general condition. The discomfort and inflammatory reaction incident to chemosurgical treatment of advanced cancer may cause a slight loss of weight and vigor, but these are regained in a few days, and there are no permanent undesirable sequelae.

Cancers which have been produced by roentgen or radium irradiation would seem particularly suitable for chemosurgical treatment, inasmuch

10. Magnussen, A. H. W.: Skin Cancer: A Clinical Study with Special Reference to Radium Treatment, Acta radiol., 1935, supp. 22, pp. 1-287.

as further irradiation is a matter of adding insult to injury, while surgical therapy is often limited to amputation.

Precancerous lesions, such as keratoses and cutaneous horns, may safely be removed with the chemosurgical technic. No recurrence or malignant change is known to have followed the chemosurgical removal of 45 such lesions from the extremities and trunk. Twenty-seven keratoses and ulcers consequent to roentgen or radium irradiation were also chemosurgically treated, with no instance of subsequent cancerous change after periods of as long as nine years. The lesions healed fairly promptly, except for 12 large sacral lesions, which healed slowly, owing to damage from the large doses of roentgen rays which had been given in the treatment of carcinoma of the uterus.

Proficiency in the chemosurgical operative technic, particularly in the interpretation of the microscopic sections, is gained only by training and constant practice. Consequently, for best results chemosurgery probably should be practiced as a specialty. Moreover, in view of the constant dependence of the operator on frozen sections of a particular type, a special clinic for the practice of this specialty is desirable.

SUMMARY AND CONCLUSIONS

In the treatment of cancer of the extremities and trunk, the chief advantages of the chemosurgical method are (1) unprecedented reliability, (2) conservatism and (3) essential lack of operative mortality. Reliability and conservatism are results of the systematic microscopic control of excision afforded by the method.

In a consecutive series of 51 cases, squamous cell carcinomas of the trunk and extremities were chemosurgically treated, with a rate of cure of 88.1 per cent after a period of observation of three years or more. In a series of 44 cases the rate of cure after five years or more was 88.6 per cent. The primary lesion was chemosurgically eradicated in all but 1 case, in which the hand of the patient was so extensively invaded that surgical amputation was resorted to (with no recurrence). Metastasis was the complication responsible for the other 4 unsuccessful results.

The rate of cure in a series of 16 cases of basal cell carcinoma of the extremities and trunk after a period of observation of three years or more was 100 per cent. In the five year period there were 10 cases, and the rate of cure was 100 per cent.

The great reliability attainable with the chemosurgical method does not entail excessively radical excision. Only 1 or 2 mm. beyond the limit of cancerous invasion need be removed.

There was no operative mortality in this series of 77 cases.

Wisconsin General Hospital.

THYROIDECTOMY AND THE PARATHYROIDS

GEORGE A. JOHNSTONE, M.D.
AND
FLORENCE VOTH-OSTENDORPH, M.D.
GLENDALE, CALIF.

THE RECOGNITION of the parathyroid glands is a challenge to the surgeon. Although the dire consequences of injury to the glands or of removal of the glands are generally appreciated, it is safe to say that thyroidectomies are done without the operator's being able definitely to recognize this tissue. The attitude of the small boy who whistles in the dark but does not turn around to see is reflected by the surgeon.

In 1937 Means[1] stated: "It is important that the surgeon be able to recognize the parathyroid glands but it is *seldom* done. It is gained only by painstaking anatomic studies in the post mortem room (not on the cadaver) where the parathyroid tissue resembles more closely that seen in living humans." He called attention to the fact that formation of hematoma is caused by the slightest trauma to the gland and that a hemorrhage diffuses through the entire gland and changes the parathyroid to a red color resembling that of the thyroid.

The surgeon will find that the best way of acquiring skill in recognition is by dissection at autopsy. Recognition is usually not learned by medical students studying anatomy, as the distortion of the color of the gland produced by the embalming fluid makes accurate recognition essentially impossible, whereas at autopsy or at the operating table the glands may be readily identified if careful intelligent search is made once their gross appearance and location are appreciated.

After an extensive review of the literature embracing the parathyroids, the surgeon is impressed with the many varied descriptions of the size, weight, color and anatomic location of the gland. Correlation of this material may be confusing. When he finds himself in the operating room performing a thyroidectomy and concerned with hemostasis, the technic of removal of the thyroid in the shortest time and the condition of the patient, there is little time for study of the recognition of the important chameleon-like parathyroids.

1. Means, J. H.: The Thyroid and Its Diseases, Philadelphia, J. B. Lippincott Company, 1937, p. 444.

To test the difficulty in recognition of parathyroid tissue and to find the most common location, one hundred dissections of the neck were done at autopsy at the Los Angeles County Hospital, and 248 specimens of what was judged to be parathyroid tissue were obtained. Microscopic sections of all tissues were made. The records of the results show that lymph nodes and thyroid tissue may be mistaken for parathyroid glands. The most common location of a parathyroid gland was found to be at the crossroads of the inferior thyroid artery and the recurrent laryngeal nerve. The next most common place was near the lower pole of the thyroid gland. In no instance were parathyroids found at or near the upper pole of the thyroid. These findings agree with those of Gilmour.[1a]

To determine the surgeon's awareness of the parathyroids, one hundred thyroidectomies performed at the White Memorial Hospital, Los Angeles, in 1945 and at the Glendale Sanitarium and Hospital, Glendale, Calif., in 1945-1946 were reviewed. Observance of the parathyroid glands was mentioned in 7 per cent of the surgical records and in 1 per cent of the pathologists' reports. This percentage is probably similar to that for hospitals in other sections of the country where similar surveys are made.

The parathyroid glands were first discovered by a Swedish anatomist, Ivar Sandstrom, in 1880.[2] In 1881 Baker described them as independent portions of the thyroid glands. Hordey identified and described them in 1884, but they were not thoroughly studied until 1892, when Gley published papers on his experiments on the external parathyroids. Koch (1895) declared that the parathyroids were separate and functionally distinct from the thyroid. In 1896 Generali and Vassele showed that fatal tetany was the result of parathyroidectomy even though a thyroidectomy was not performed. However, if one parathyroid remained, tetany did not occur. It was not until 1910 that it was finally proved that these glands are important to life.

POSITION

The location of the parathyroids is varied, and they are rarely symmetric in arrangement. They may be found in a normal position on one side while one or more on the other side may be considerably above, below or lateral to the area where they are normally found. This, of course, makes them more difficult to find.

1a. Gilmour, J. R.: Gross Anatomy of the Parathyroid Glands, J. Path. & Bact. **46**:133-149 (Jan.) 1938.

2. Richardson, H.: The Thyroid and Parathyroid Glands, Philadelphia, P. Blakiston's Son & Co., 1905, (*a*) p. 16; (*b*) p. 29.

Ochsner and Thompson [3] and Crotti [4] located the superior parathyroids opposite the cricoid cartilage or at the level of the cricoid cartilage. Ochsner and Thompson also called attention to the fact that they could usually be found at the entrance of the end branches of the inferior thyroid artery. Hadfield and Garrod [5] gave the same location. Crotti [6] recorded that "the arterial branches and the inferior laryngeal nerve pass in front and internal to them."

Cowdry,[7] Shelling,[8] Sloan [9] and Wolf [10] described the location of the parathyroids as being at the junction of the upper and middle thirds of each lobe of the thyroid. Rolleston [11] noted them among the branches of the superior thyroid artery.

The inferior parathyroids were located by Klotz,[12] Cowdry,[7] Shelling,[8] Sloan [9] and Wolf [10] at the posterior lateral lobes of the thyroid gland. Cowdry and Shelling further stated that they were occasionally near the inferior thyroid veins and the esophagus, in the thorax or embedded in the thymus. Cowdry added that they had been recorded as being as far caudad as the areolar tissue about the pericardium He suggested the best clues to the location of both glands as being associated with the inferior thyroid arteries. Wolf [10] was of the opinion that the inferior parathyroids were twice as likely to be found buried in the thyroid gland or in the thymus. Crotti [4] and Sloan [9] stated that they could be found external to the inferior laryngeal nerve and that they may be found at the extremity of the lower pole, under the lower

3. Ochsner, A. J., and Thompson, R. L.: The Surgery and Pathology of the Thyroid and Parathyroid Glands, St. Louis, C. V. Mosby Company, 1910, pp. 206-211.

4. Crotti, A.: Diseases of the Thyroid, Parathyroids and Thymus, ed. 3, Philadelphia, Lea & Febiger, 1938, pp. 86-88.

5. Hadfield, G., and Garrod, L. P.: Recent Advances in Pathology, Philadelphia, P. Blakiston's Son & Co., 1932, p. 363.

6. Crotti,[4] p. 88.

7. Cowdry, E. V.: Endocrinology and Metabolism, Baltimore, Williams & Wilkins Company, 1922, vol. 1, pp. 501-506.

8. Shelling, D. H.: The Parathyroids in Health and Disease, St. Louis, C. V. Mosby Company, 1935, (*a*) p. 25; (*b*) p. 31; (*c*) p. 36; (*d*) p. 37.

9. Sloan, E. P.: The Thyroid, Springfield, Ill., Charles C Thomas, Publisher, 1936, (*a*) p. 376; (*b*) p. 377; (*c*) p. 379.

10. Wolf, W.: Endocrinology in Modern Practice, Philadelphia, W. B. Saunders Company, 1937, (*a*) p. 353; (*b*) p. 354.

11. Rolleston, H. D.: The Endocrine Organs in Health and Disease, London, Butterworth & Company, Ltd., 1936, p. 277.

12. Klotz, O.: Endocrinology and Metabolism, Toronto, University of Toronto Press, 1922, vol. 1, p. 559.

border of the isthmus or even embedded in the thymus. Crotti [6] suggested that they were found most constantly at the entrance, or thereabouts, of the inferior thyroid artery into the gland. Hadfield and Garrod [5] described them as being behind or below and within 1 cm. of the lower poles. Rolleston [11] recorded the location as being near the inferior thyroid artery.

EMBRYOLOGY

All authors agree that the superior parathyroid arises from the third branchial cleft and the inferior parathyroid from the fourth cleft. Shelling [8] and Cowdry [7] pointed out the fact that embryologically the inferior parathyroids should be situated anteriorly but that this position is occupied by the superior parathyroids. They explained this by stating that the inferior parathyroids in their general caudad migration from the branchial cleft outdistance the thyroid and the superior parathyroids.

However, Norris,[13] writing in 1937, did not agree with this. He maintained that "the primordium of the human parathyroid III arises from the anterior face of the third branchial pouch. The primordium of the human parathyroid IV arises from the dorsal edge of the fourth branchial pouch. . . . Parathyroids III and IV grow at approximately the same rate. Their growth is at first slow, and not until the fetus is about 100 mm. long, does a more rapid growth rate appear." He also stated that "the point at which the parathyroids become isolated is determined in part by the degree of shifting or migration which takes place in the case of the two branchial complexes."

SHAPE AND COLOR

The parathyroids are described by Sloan,[9] Berman,[14] Wolf,[10] Rolleston,[11] Shelling,[8] Reinhoff,[15] Gilmour,[16] Maximow,[17] Ochsner and Thompson,[3] Gray [18] and Cunningham [19] as being small oval bodies somewhat flattened in shape. Cowdry [7] mentioned that they are small and bean shaped, while Richardson [2] merely said that they are flattened bodies. Means [1] stated that they are flat and sometimes like an elongated

13. Norris, E.: Thymoma, Contrib. Embryol. **26**:292, 1937.

14. Berman, L.: The Glands Regulating Personality, New York, The Macmillan Company, 1922, (*a*) p. 91; (*b*) p. 92.

15. Reinhoff, W. F., Jr.: Diseases of the Parathyroid Glands, in Lewis, D.: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1947, vol. 6, chap. 2, (*a*) p. 1; (*b*) p. 2; (*c*) p. 3.

16. Footnote deleted.

17. Maximow, A. A.: Textbook of Histology, ed. 4, Philadelphia, W. B. Saunders Company, 1930, p. 702.

18. Gray, H.: Anatomy of the Human Body, edited by W. H. Lewis, ed. 23, Philadelphia, Lea & Febiger, 1936, p. 1260.

19. Cunningham, D. J.: Cunningham's Textbook of Anatomy, edited by J. C. Brash and E. B. Jamieson, ed. 8, New York, Oxford University Press, 1943, p. 786.

pancake and that they assume the contours of their surroundings, being like a cigar if stretched out along a blood vessel, flat if on an open surface of the thyroid and triangular if molded into a thyroid sulcus. Crotti [6] described them as being oblong and flattened.

There is little more difference of opinion in regard to their color. Most of the authors, such as Sloan, Berman, Wolf, Hadfield and Garrod, Moore,[20] Reinhoff, Maximow and Cunningham, mentioned that they are of a yellowish brown or yellowish red color. However, Curschmann [21] and Richardson [2] stated that they are reddish, while Bell [22] and Gray [18] called them a reddish brown. Ochsner and Thompson [3] referred to them as being a pale gray-white to a dark reddish brown. In 1918 Crotti [4] said that they may be brownish, yellow-brown or even an orange hue, but in 1938 he stated that they varied in color from light to dark mahogany brown "according to their blood content." [6] He also mentioned that some were pale white because of the "fatty infiltration of the glands."

Gilmour [18] described them thus:

Newborn to 3 months	Gray
6 to 10 years	Gray-white with a yellow tinge
11 to 20 years	Yellow with pinkish brown element

It is interesting to note the size and weight of the glands as given by the different authors (tables 1 and 5).

Hadfield and Garrod [5] and Rolleston [11] all mentioned that the lower parathyroids are larger, often being twice the size of the upper ones. Shelling [8] said that the parathyroid glands in infants and children were about one-fourth the size of an adult's, and Gilmour [16] noted that they were usually larger in females than in males.

The number of parathyroids vary, the average being four. Gilmour stated that in four hundred and twenty-eight dissections, 1,713 glands were found, an average of 4 in each. He lists them as shown in table 2.

Crotti [4] examined 75 cadavers in order to determine the number of parathyroids in each (table 3).

In the instances in which Crotti did not find any parathyroid glands he noted that parathyroid tissue was diffusely embedded in the fat and in the areolar tissue throughout the posterointernal region of the thyroid.

Those who reported the finding of rather unusual numbers of glands are listed in table 4.

---

20. Moore, R. A.: Textbook of Pathology, Philadelphia, W. B. Saunders Company, 1929, p. 50.

21. Curschmann, H.: Endocrine Disorders, New York, Oxford University Press, 1929, p. 50.

22. Bell, E. T.: Textbook of Pathology, Philadelphia, Lea & Febiger, 1934, p. 615.

TABLE 1.—*Size of the Parathyroid Glands According to Various Authors*

	Length, Mm.	Width, Mm.	Thickness, Mm.
Ochsner and Thompson [3]	6 to 7	3 to 4	1½ to 5
Sloan [9]	5 to 7	2 to 4	1½ to 2½
Shelling [6]	6	3 to 4	2 to 3
Cowdry [7]	6	3	2
Wolf [10]	6 to 10	3 to 6	2 to 4
Rolleston [11]	6	4	2
Moore [20]	6 to 10	3 to 6	2 to 4
Bell [22]	6	3	3
Welsh, cited by Shelling [6]	6 to 7	4	
Erdheim, cited by Shelling [6]	8	5	
Verebeley, cited by Shelling [6]	2 to 19	1 to 4	
Noller, cited by Shelling [6]	3 to 16	1 to 3	
Falta, W., and Meyers, M. K.: Endocrine Diseases, Philadelphia, P. Blakiston's Son & Co., 1923, p. 184	3 to 15	2	
Sandstrom and Benjamin, cited by Shelling [6]	3 to 15		
Ebner, cited by Shelling [6]	3 to 13		
Berman [14]	About the size of a wheat seed		
Berkeley, W. N.: Principles and Practice of Endocrine Medicine, Philadelphia, Lea & Febiger, 1926, p. 121	About as large as a small grain of maize		
Curschmann [21]	About the size of a lentil		
Adami, J. G.: Principles of Pathology, Philadelphia, Lea & Febiger, 1910, p. 355	The size of a pea or thereabouts		

TABLE 2.—*Number of Parathyroid Glands Found by Gilmour* [12a]

Number of Glands Found	Number of Times
2	1
3	26
4	374
5	25
6	2

TABLE 3.—*Number of Parathyroid Glands Found by Crotti* [4]

Number of Glands Found	Number of Times
1	4
2	32
3	26
4	11
0	2

TABLE 4.—*Number of Parathyroid Glands Found by Various Authors*

	Number of Glands	Number of Times
Erdheim, cited by Shelling [6]	8	1
MacCallum, cited by Shelling [6]	10	1
Verebley, cited by Shelling [6]	12	Several
Peterson, cited by Shelling [6]	2	2

Norris [13] reported that he has not found less than four parathyroids in any case and that approximately 2 per cent of his patients had five. MacCallum found five pairs in a case of gastric tetany.

Rolleston [11] stated that the glands in females weigh more than those in males.

We found that we could agree with all the authors as to the size, shape, color and weight of the glands. In renal disease especially we frequently found one parathyroid to be small and several of the others to be extremely large, and in a particular case the color varied from yellowish brown to dark mahogany brown.

We believe that such a variance of color is due to a mixture of thymus tissue with parathyroid gland tissue. The pathologist reported the presence of thymus tissue in a number of cases, but no study was made of the percentage.

TABLE 5.—*Weight of Parathyroid Glands*

	Weight, Mg.
Shelling [8]	35 to 55 (each gland)
Cowdry [7]	55 (each gland)
Means [1]	20 to 60 (each gland)
Moore, cited by Bell [23]	40 to 80 (each gland)
Welsh [6]	35 (each gland)
Wolf [10]	500 (total glands)
Rolleston [11]	About 480 (total glands)
Bodansky, M., and Bodansky, O.: Biochemistry of Disease, New York, The Macmillan Company, 1940, pp. 365-374.	120 (total glands)
Danisch, cited by Shelling [8]	20 (1 to 10 yr.) 28 (11 to 20 yr.) 37 (20 to 30 yr.) 38 (30 to 60 yr.) 40 (40 to 80 yr.)

Frequently the parathyroids are surrounded by thymus tissue and fat, which must be removed before one can definitely recognize them.

We found, incidentally, that the most common cause of hyperplasia of the parathyroids is renal disease.

HISTOLOGIC NATURE

Types of the glands, as given by Sloan,[9] are (1) the compact uniform type of early life, (2) the anastomosing strand type of adult life and (3) the lobular type of later life. The principal cells appear to be the essential ones representing the type present in man up to the tenth year as well as clear, poorly staining, nongranular protoplasmic cells with large, pale nuclei. Oxyphil cells appear in late childhood, are longer than the chief cells, occur singly or in groups, have large amounts of granular protoplasm which stains with acid dyes and contains nuclei which are much smaller than those in the chief cells and in which the chromatin stains deeply. All authorities agree that the blood supply for

the parathyroids is large and that it comes from a branch of the inferior thyroid artery. This branch, after penetrating the capsule, breaks up into numerous branches which go through tissues of the organs. The blood then goes through the capillaries into a venous plexus on the surface of the gland which communicates with the thyroid veins (Cowdry [7]). Reinhoff [15] stated that the parathyroid artery is small, about 4 or 5 mm.

When Evans found in 1907 that each parathyroid had a special supply from the branches of the inferior thyroid artery, it was believed that this was the only blood supply to the gland. However, a little later Ginsburg [3] called attention to the existence of a secondary blood supply to the glands through anastomotic channels from the opposite side; even if the superior and inferior arteries should be ligated outside the capsules, the glands would still have a blood supply from the opposite side.

The nerve supply is scanty, and it apparently escaped observation until the work of Rhinehardt was carried out about ten years ago.

TABLE 6.—*Nature of 248 Specimens of Tissue Judged Grossly to Be Parathyroid Tissue*

Tissue	Sections	Percentage of Total
Parathyroid	191	77
Lymph nodes	32	13
Thyroid tissue	25	10
Total	248	100

It is derived from the sympathetic nerves entering the parathyroids. Crotti [6] stated that "no direct branches are known coming directly from the parasympathetic. However, as the thyroid gland receives its parasympathetic supply from the superior laryngeal nerve and a few fibers from the recurrent nerve, it is probable that some small parasympathetic filets reach the parathyroids through this channel."

Cowdry [7] mentioned that the exact mode of termination of the fibers is not definitely known. He stated that some of them are certainly vasomotor in nature and that fibers ending on and between the gland cells have been recorded.

To test the difficulty in recognizing parathyroid tissue, 248 specimens were obtained from one hundred postmortem examinations and submitted for microscopic study by the pathologist. Of these specimens thought macroscopically to be all parathyroid tissue, 191, or 77 per cent, proved to be parathyroid tissue, 32, or 13 per cent, proved to be lymph nodes and 25, or 10 per cent, were found to be thyroid.

This surely proves that the recognition of parathyroid tissue requires painstaking care and skill, which can be acquired only by the per-

formance of hundreds of careful dissections, the accuracy of which should be checked by microscopic section.

In order to estimate the average surgeon's consciousness of the parathyroids, the records of one hundred operations on the thyroid gland performed in 1945-1946 were reviewed. These were performed by nineteen different operators. Of the records studied, seven mentioned visualization of the parathyroids and one mentioned that the parathyroids were not seen. One pathologist's report noted the presence of parathyroid tissue on microscopic section, and one other report commented that parathyroid tissue was not seen.

In view of the importance of the parathyroid glands, it is suggested that all surgical records contain a statement concerning the visualization or nonvisualization of the glands and the position in which they are found.

When a thyroidectomy is being done, the first concern of the surgeon is to locate the parathyroids. In order to avoid their removal, he must be careful to prevent extensive bleeding. They are much more easily

TABLE 7.—*Analysis of 100 Surgical Reports and Pathologists' Reports on Routine Operations on the Thyroid*

	Number of Cases
Parathyroid tissue mentioned by surgeon as seen	7
Parathyroid tissue mentioned by surgeon as not seen	1
No mention of parathyroid by surgeon	92
Pathologist's report of parathyroid tissue seen	1
Pathologist's report of parathyroid tissue not seen	1
No mention of parathyroid by pathologist	98

located if there is a dry field and if the thyroid is not handled roughly. Hertzler [23] gives these instructions:

> The largest parathyroid and the one most endangered at operation is located in the region of the inferior thyroid veins. It is commonly exposed when these vessels are isolated, and it is an easy matter to grasp them between the parathyroid and thyroid itself. If the parathyroid is not visible, by grasping the vessels close to the capsule of the thyroid, one may be sure that one is not endangering them. If one sees a vessel and grasps only the vessel, it follows that he is grasping nothing else. This is the fundamental fact to be kept in mind in removing the thyroid gland. The other parathyroids, situated cephalad, are not endangered if one stays within the capsule. Even if the superior and inferior arteries are ligated at their source, the parathyroids are abundantly supplied with collateral circulation with the vessels about the esophagus. This has been demonstrated in the laboratory, and clinical experience has abundantly proved it.

Wolf [10] stated that parts of the anterior, lateral and posterior regions of the capsule must be preserved. As a rule, all are embedded in loose areolar tissue and can thus be shielded from injury.

23. Hertzler, A. E.: Diseases of the Thyroid Gland, New York, Paul B. Hoeber, Inc., 1941, p. 597.

The upper parathyroids lie in such close relationship to the nerves that if the latter are left intact and are exposed as they should be when the gland is turned outward the parathyroids will be left undisturbed when the loose areolar structures are brushed back. The technic of the operation is now so improved that injury to the glands from pressure, hemorrhage or scar formation following thyroidectomy can as a rule be avoided.

The recognition of the parathyroid glands is a challenge to the surgeon, and the inclusion of a statement in the surgical report in regard to visualization or nonvisualization is an important scientific contribution. Return to the autopsy room for study in recognition, and return to the record room for accuracy in description!

SUMMARY

1. The recognition of the parathyroid glands is important, but it is seldom made.

2. The lack of recognition is due to (*a*) training in the anatomy laboratory rather than observance of living tissue or tissue seen at postmortem examination; (*b*) confusion caused by the wide range in the description of the position, color, size and number of glands, and (*c*) the similarity in appearance of the thyroid and the parathyroid tissue with hemorrhagic areas and lymph nodes.

3. As a test to determine the difficulty in recognition of parathyroid tissue, 248 specimens were obtained of what was judged to be parathyroid tissue from one hundred postmortem examinations and submitted for microscopic examination by the pathologist. One hundred and ninety-one specimens proved to be parathyroid tissue, 32 were lymph nodes and 25 were thyroid gland. The incidence of a recognition was 77 per cent.

4. The most common location of a parathyroid gland was found to be at the crossroads of the inferior thyroid artery and the recurrent laryngeal nerve. The next most common place was near the lower pole of the thyroid gland. In no dissection were parathyroids found at or near the upper pole of the thyroid.

5. To demonstrate that the surgeon's record still has little to say about the recognition of parathyroid glands, one hundred reports on operations on the thyroid performed in 1945-1946 were reviewed. Seven surgical reports described visualization of parathyroid glands, one stated that no parathyroid glands were seen and ninety-two made no statement in regard to the presence or absence of the parathyroids.

6. A more determined study in the recognition of the parathyroid gland is essential, and a more definite statement in the surgical report concerning visualization or nonvisualization of the glands is suggested.

SUBPHRENIC ABSCESS

PATRICK C. SHEA Jr., M.D.
ATLANTA, GA.
AND
WILLIAM D. HOLDEN, M.D.
CLEVELAND

SUBPHRENIC abscess, although infrequent, is a grave complication of abdominal suppuration. During the past fifteen years, the introduction of antibiotic preparations and the use of an extraserous type of surgical drainage have contributed to the successful management of patients with subphrenic abscess. The mortality rate, however, remains higher than should reasonably be expected. There are many factors which contribute to a high mortality rate in this disease, and we believe that a discussion of such factors may be of benefit. Diagnosis has been notoriously difficult and localization of the abscess almost conjectural. The time interval between the onset of intraperitoneal suppuration and the diagnosis of subphrenic abscess is unduly long. A successful extraperitoneal drainage requires familiarity with the anatomy of the subdiaphragmatic spaces and careful avoidance of contamination of the pleural and peritoneal cavities.

This report includes 40 cases seen during the past twelve years at University Hospitals of Cleveland. Diagnosis was confirmed by autopsy or operation or, in 2 instances, by aspiration alone. In all but 2 of the cases the abscess followed intraperitoneal suppuration. Comparisons will be made with previous reports, but we wish to stress the clinical manifestations and the various difficulties that complicate the management of patients with this condition.

In 1933, Ochsner and Graves[1] collected 3,322 cases of subphrenic abscess from the world literature and presented 50 additional ones. Their report will be referred to frequently. They described the subphrenic spaces in detail and analyzed the frequency of abscess formation in the various spaces. In table 1 are compared the sites of abscess in the collected series, in Ochsner's cases and in our own.

From the Department of Surgery, University Hospitals of Cleveland and Western Reserve University School of Medicine.

1. Ochsner, A., and Graves, A. M.: Subphrenic Abscess: An Analysis of 3,372 Collected and Personal Cases, Ann. Surg. **98**:961 (Dec.) 1933.

ETIOLOGY

The subphrenic spaces may become infected by direct intraperitoneal extension, rupture of adjacent abscesses, lymphatic extension, direct implantation following penetrating wounds or dissemination by way of the blood stream from distant infectious processes. The most frequent primary lesions observed in our series were perforations of the appendix, stomach or duodenum (table 2). Cultures of

TABLE 1.—*Location of Subphrenic Abscesses*

Space Involved	University Hospitals' Cases, per Cent	Ochsner's Own Cases,[1] per Cent	Ochsner's Collected Cases,[1] per Cent
Right posterior superior	45	60	28.8
Right inferior	7.5	13.5	8.9
Right anterior superior	17.5	8	12.7
Retroperitoneal	0	8	14.4
Left anterior inferior	0	8	20.2
Left posterior inferior	0	0	3
Left superior	5	2	3.6
Combined	20	8	3.4
Not determined	5	0	4.7

TABLE 2.—*Site of Primary Lesion*

Site of Primary Lesion	University Hospitals' Cases, per Cent	Ochsner's Collected Cases,[1] per Cent	Ochsner's Own Cases,[1] per Cent	Hochberg's Cases [2]
Stomach and duodenum	42.5	29	28	6
Appendix	25	30	26	21
Liver and biliary tract	15	12	18	31.5
Pelvic organs	7.5	1.5	2	2
Pancreas	2.5	1.4	0	0
Miscellaneous	5	25.8	18	24
Unknown	2.5	0	0	16.5

material from the abscess yielded pathogens in 75 per cent of our cases and in the other 25 per cent cultures either were sterile or were not made. When cultures were taken, organisms of the Escherichia coli group were present in 38 per cent, streptococci in 32 per cent and staphylococci in 25 per cent of the abscesses; and in 5 per cent cultures were sterile. This distribution is comparable to that in Ochsner's series, with E. coli in 40 per cent, streptococci in 40 per cent and staphylococci in 20 per cent. In 10 of our 40 cases there were mixed infections of two and, on some occasions, three organisms.

CLINICAL MANIFESTATIONS

At any time during its course, subphrenic abscess may be confused with pleural effusion, pneumonia, empyema, or subhepatic or abdominal abscess. Any one or all of these conditions may be present simultaneously. In 1 instance, the diagnosis of malaria was considered for a short time in a case of subphrenic abscess. Ochsner and Graves [1] stated that subphrenic infections occur more frequently than is supposed and that in their experience only 30 per cent of them proceed to abscess formation. Hochberg,[2] in a review of 139 cases, presented an excellent critical discussion of the diagnostic criteria of the disease. He emphasized that if one keeps the disease in mind and examines the patient carefully the diagnosis may be made without undue difficulty. We believe, however, that the diagnosis is difficult. The only pathognomonic sign is roentgenographic visualization of

TABLE 3.—*Five Clinical Observations in 40 University Hospital Cases*

Observations	Number of Cases	Occurrence, Percentage
Leukocytosis (above 10,000 cells per cu. mm.)	38	95
Septic temperature (above 38 C. [100.4 F.])	40	100
Local pain and tenderness	36	90
Thoracic pain (both thoracic and local pain, 1 case)	4	10
No pain	1	2.5
Fluid in chest	35	87
Referred pain to shoulder	12	30
Hiccup	3	7.5
Elevated and fixed diaphragm	36	90
Icterus	15	37

encapsulated gas, and this occurs so late and is present so infrequently that it is of little assistance. Persistent fever, leukocytosis, local pain and tenderness and an elevated, fixed diaphragm are the usual manifestations that lead the surgeon to suspect the presence of a subphrenic abscess (table 3). An elevated diaphragm, roentgenographically observed, is often the first indication that a subphrenic infection is developing. When this sign is observed either clinically or roentgenographically, and the patient's general condition permits, fluoroscopic examination of the chest should be performed to determine whether or not the diaphragm is fixed. An elevated diaphragm is not uncommonly seen after laparotomy, but unless fixation of the diaphragm is observed a diagnosis of subphrenic abscess should be made with hesitation. This sign was present in 90 per cent of the University Hospitals' patients.

2. Hochberg, L. A.: Diagnostic Criteria for Subphrenic Abscess Based upon a Study of One Hundred and Thirty-Nine Cases, Ann. Int. Med. **17**:183 (Aug.) 1942.

The 40 patients in the present series were hospitalized for an average of forty-nine days. In the cases in which a laparotomy was done, diagnosis was first suspected on an average of fifteen days after the original operation. The average period from the time a subphrenic abscess was first suspected to the time when surgical drainage was performed was 15.3 days. In the cases in which the patients died (including those operated on and those who were not), the average time from diagnosis to death was 19.5 days.

TREATMENT

There are four surgical approaches for drainage of a subphrenic abscess: Transperitoneal, transpleural and retroperitoneal drainage, and aspiration. In 10 of the 40 cases in this series, no operation was performed; in 20 retroperitoneal drainage was used; in 8, transpleural drainage, and in 2, aspiration alone. The method of choice is retroperitoneal drainage, as has been pointed out elsewhere,[3] and as is obvious from a review of our own cases. The technic of extraserous drainage is adequately outlined in texts and in other reviews.[3] Aspiration of a subphrenic abscess transperitoneally or transpleurally is dangerous and contrary to all surgical principles. It is mentioned only to be condemned. After surgical exposure has been obtained, aspiration under direct vision may aid the surgeon in planning drainage from one or more infected spaces. Constant suction during the introduction of the needle should be applied lest a cavity be transgressed and uninfected areas be contaminated. Hochberg [2] cited an instance in which death occurred three hours after transpleural aspiration. During the course of extraserous exposure of the abscess, great care must be exerted to avoid opening the peritoneum or pleura. This is especially true in the anterior subcostal approach to an abscess in the right anterior superior space. In 1 of our cases the pleura was inadvertently opened at operation, and the patient died three hours after the procedure.

In our series, penicillin was given in 9 cases in doses of 15,000 to 20,000 units every three to four hours. In 6 of these cases sulfadiazine was also given, either orally or intravenously. Retroperitoneal drainage was performed in 6 of the 9 cases, and all the patients survived. In 1 of the 9 cases, transpleural drainage was used, and the patient survived. In 2 of these cases, no operation was performed and the patients died.

The maintenance of a positive electrolyte, fluid, protein and hemoglobin balance is of utmost importance during both the preoperative and the postoperative period.

---

3. Ochsner and Graves.[1] Hochberg.[2]

MORTALITY

In the 40 cases of patients with subphrenic abscess seen in University Hospitals in Cleveland in the past twelve years, 20 patients died, a mortality rate of 50 per cent. This figure includes both patients who were and those who were not subjected to surgical treatment.

In 10 of the 40 cases, no surgical treatment was given, either because of failure to make the diagnosis or because permission to operate was refused. In 8 of these 10 cases the patients died; the mortality rate was 80 per cent. In Ochsner's collected series [1] there were 1,072 cases in which no operation was performed; the mortality rate was 91 per cent.

In the 30 cases in our series in which the operation was done, the mortality rate was 40 per cent. Ochnsner [1] reported a mortality rate of 32 per cent in 50 similar cases of his own, and one of 33.6 per cent in 1,693 similar cases in the collected series. Hochberg [2] reported a mortality rate of 25 per cent in 139 cases. In 8 cases in our series in which a

TABLE 4.—*Mortality Rate of Subphrenic Abscess According to Decade of Life*

Decade of Life	University Hospitals' Cases, per Cent	Ochsner's Cases,[1] per Cent
First	33	0
Second	50	10
Third	0	33
Fourth	25	44
Fifth	63	37
Sixth	67	25
Seventh	100	33

transpleural operation was performed, the mortality rate was 50 per cent. Ochsner [1] reported a mortality rate of 50 per cent in 28 of his cases, and a mortality rate of 39 per cent in 612 collected cases in which this surgical approach was used. The retroperitoneal approach was used in 20 cases in our series, and 6 patients died; the mortality rate was 30 per cent. The causes of death in these 6 cases were as follows: coronary thrombosis, 1 case; septicemia, 2 cases; multiple abdominal abscesses and empyema, 1 case; peritonitis and pulmonary abscess, 1 case, and shock, 1 case. It is at once apparent that 4 of these deaths resulted from the original suppurative process and cannot be ascribed to the type of operation employed.

A review of the mortality rate according to decades (table 4) shows that the highest rate occurred in the younger and older age groups; this observation is consistent with what one would expect in cases of severe suppurative infection. These figures are at variance with Ochsner's observations.

COMPLICATIONS

The most frequent complications of subphrenic abscess are pneumonia and empyema (table 5). The latter complication occurred in 1 case after transpleural drainage, in a second after transpleural aspiration and in a third after spontaneous necrosis of the diaphragm and rupture of the abscess into the pleural cavity. Early operation and avoidance of transpleural aspiration or operation should reduce the incidence of empyema.

TABLE 5.—*Incidence of Complications*

Complications	University Hospitals' Cases, per Cent	Hochberg's Cases,[2] per Cent
Bronchopneumonia	50	71.9
Pleural effusion	35	25.9
Atelectasis	32.5	0
Empyema	25	12
Hepatic abscesses	7.5	0
Septicemia	7.5	0
Bronchopleural fistula	5	3.6
Abscess of lung	5	7.2
Pulmonary embolus	2.5	0.7
Coronary thrombosis	2.5	0
Pericarditis	0	2.1
Mediastinal abscesses	0	0.7
None	12.5	....

Although pleural effusion and atelectasis are included in the table of complications, we do not consider them seriously, since adequate drainage of the subdiaphragmatic abscess results in prompt, spontaneous absorption of the pleural effusion and disappearance of the atelectasis.

CONCLUSIONS

Although subphrenic abscess has been observed in only 40 cases in the past twelve years at University Hospitals of Cleveland, it is an important clinical entity and the mortality rate is high.

Retroperitoneal drainage is the procedure of choice in treatment of subphrenic abscess and has the lowest surgical mortality rate.

Penicillin, alone or combined with sulfadiazine, and the use of retroperitoneal drainage produce the most satisfactory results. In 6 cases in which this treatment was recently used there were no deaths.

CARCINOMA OF THE LUNG WITH INTRACRANIAL METASTASIS

Successful Removal of Metastatic and Primary Lesions

H. THOMAS BALLANTINE Jr., M.D.
BOSTON
AND
FRANCIS X. BYRON, M.D.
ANN ARBOR, MICH.

THE FREQUENCY with which carcinoma of the lung metastasizes to the brain has been a matter of interest during the past twenty-five years. Dosquet,[1] in 1921, published one of the earliest reports on this subject, and Tinney and Moersch,[2] in 1944, presented one of the latest. The latter authors have summarized various opinions on the subject. The incidence of intracranial metastasis from carcinoma of the lung is variously given as from 16.5 per cent (Ochsner and DeBakey, 1942[3]) to 36.3 per cent (Olson, 1935[4]). The average figure compiled from several sources is 23 per cent.

The accepted theory for the frequency with which the brain is the site of metastasis is based on the fact that carcinoma cells can enter the blood stream without passing through the capillary filter of the lung and are thus more likely to reach the brain.

That the usual prognosis for such patients is a gloomy one is not surprising. Tinney and Moersch,[2] in reviewing 448 cases of carcinoma of the lung, observed that the average duration of life for the total group was 14.5 months after the diagnosis had been made. The 19 patients in this series who had metastases to the central nervous system at that time lived an average of six months only.

A distinction should be made, however, between a gloomy outlook and a hopeless one. This is a differentiation which seldom appears in the literature. Moreover, the surgeon dealing with cancer must strive

---

From the Department of Surgery, University Hospital, Ann Arbor, Mich.

1. Dosquet, A.: Ueber die Metastasenbildung bei primären Lungen und bronchial Krebses, Virchows Arch. f. path. Anat. **234**:491, 1921.

2. Tinney, W., and Moersch, H.: Intracranial Metastasis of Carcinoma of the Lung, Arch. Otolaryng. **39**:243 (March) 1944.

3. Ochsner, H., and DeBakey, M.: Significance of Metastasis in Primary Carcinoma of the Lungs: Report of Two Cases with Unusual Site of Metastasis, J. Thoracic Surg. **11**:357-387 (April) 1942.

4. Olson, K. B.: Primary Carcinoma of the Lung, Am. J. Path. **11**:449-468 (May) 1935.

for one of two goals, cure or palliation, rather than for the single objective of a complete cure. The patient with carcinoma deserves most serious consideration before being denied an opportunity for prolongation of life. That patients with intracranial metastasis from carcinoma of the lung do not have a uniformly hopeless outlook is shown by the following reports from the literature.

Fried and Buckley[5] (1930), reporting on 38 patients with primary carcinoma of the lung, noted that 15 had had metastases to the brain. This observation was verified by operation or necropsy or both. Eleven of these patients were subjected to operation in the neurosurgical service of the Peter Bent Brigham Hospital. There were 5 postoperative fatalities. Of the remaining 6 patients, 1 lived two months; 1, five months; 1 seven months; 1, two years and four months, and another, two years and six months. The remaining patient lived seven years after craniotomy. It should also be emphasized that none of these patients had had removal of the primary lesion. These authors stated:

> It is the opinion in this clinic that, as a rule, surgery is indicated in such cases even though one is conscious that the lesion is a metastasis. For in instances in which the intracranial lesion was solitary, its removal with the leaving behind of the usual decompression has led to a prolongation of the patient's life and has spared him much suffering caused by an expanding intracranial lesion.[5]

Craig, Woltman and Kernohan,[6] in 1939, reported 6 selected cases of carcinoma of the lung with intracranial metastasis. Two patients were not operated on; 2 died four to seven days after operation; 1 lived four months, and 1, six months. The last 2 patients were relieved of their primary presenting symptoms until the time of their death.

It is interesting to note that the patient who lived four months after operation had only a single intracranial metastasis to the left gasserian ganglion. There was no other extension, local or general, from the primary carcinoma in the lower lobe of the left lung. The immediate cause of death was said to have been bronchopneumonia. These authors commented as follows:

> Metastasis of carcinoma to the central nervous system is not uncommon. The primary lesion is usually found, however, before any neurosurgical interference is undertaken and is usually considered adequate reason for not attempting such measures. Experience probably justifies this course in most instances. Usually there are metastases elsewhere. When the tumor in the brain is the only demonstrable metastatic lesion and the primary carcinoma is small and slowly growing, enucleation of the cerebral lesion may be justified.[6]

---

5. Fried, B. M., and Buckley, R. C.: Primary Carcinoma of the Lungs: IV. Intracranial Metastasis, Arch. Path. **9**:483-527 (Feb.) 1930.

6. Craig, W. McK.; Woltman, H. W., and Kernohan, J. W.: Metastasis to the Central Nervous System from Carcinoma of the Lung, Am. J. Cancer **36**:12-24 (May) 1939.

It is obvious from these reports that intracranial operation was often undertaken in the belief that the surgeon was dealing with a primary tumor of the brain. Occasionally, also, craniotomy was performed as a palliative measure. Nowhere have we found a report in which an attack on both the metastatic lesion in the brain and the source of the metastasis in the lung was deliberately planned before either lesion had been operated on. Hence, the following case should be of interest.

B. W., a white man aged 54, was admitted to the neurologic service of the University of Michigan Hospital on Dec. 13, 1946. His chief complaint was weakness of the left arm and leg of two months' duration. One month prior to admission he had the first of six jacksonian epileptic attacks. These began with uncontrolled movements in the left foot, progressing to the leg, and then to convulsive movements of the entire left side of the body. The usual duration of attacks was given as from five to fifteen minutes. There was no loss of consciousness. The patient had also noted, for three weeks prior to admission, that if he grasped an object with his left hand it was difficult for him to release his grip. For about a week he had had a moderately severe headache, localized to the frontal region.

The past history was irrevelant except that his weight had dropped in six months from 170 to 142 pounds (77.1 to 64.4 Kg.). There was no history of chronic cough or thoracic pain.

General physical examination revealed good development, with evidence of recent loss of weight. There was obvious weakness of the left side of the body. The chest appeared clear on percussion and auscultation. Psychologic examination demonstrated that the patient was of average intelligence, with no apparent deficit or abnormality of thought content. Sensation was normal throughout in all modalities. The cranial nerves were normal; no papilledema was apparent on funduscopic examination. Examination of the motor system revealed, except for the face, generalized weakness of the left side of the body, more pronounced in the lower than in the upper extremity. The tendon reflexes were slightly increased in the left upper extremity and definitely increased in the left lower extremity. No other reflex changes were elicited.

Roentgenologic examination of the skull revealed nothing abnormal. A routine roentgenogram of the chest, however, revealed a homogeneous mass of increased density at the apex of the right lung. A tentative diagnosis of bronchogenic carcinoma was made by the roentgenologist. Bronchoscopic study was not informative. Fluoroscopic examination of the chest following bronchoscopy demonstrated that the right side of the diaphragm moved normally.

Electroencephalographic recordings indicated the presence of a space-occupying lesion in the right frontoparietal area. It was the consensus, despite the lack of confirmatory bronchoscopic observations, that the patient had a carcinoma of the upper lobe of the right lung which had metastasized intracranially to the posterior part of the right frontal lobe. Accordingly, the patient was transferred to the neurosurgical service for further treatment. Unfortunately, during the period necessary for diagnostic study, the neurologic symptoms progressed, with complete paralysis of the left arm and hand and almost complete paralysis of the left leg. His convulsions, while not severe at any time, became much more frequent and prolonged. On December 26, a contrast roentgenogram of the right internal carotid artery was made, with local anesthesia. The films were not completely satisfactory but were suggestive of a space-occupying lesion in the right anterior parietal area, encroach-

ing on the posterior superior portion of the right frontal lobe. On Jan. 1, 1947, a pneumoventriculogram confirmed the findings of the arteriogram. On the following day an osteoplastic craniotomy was performed in the right frontoparietal region.

At operation, a subcortical cyst was observed in the region of area 4. It was filled with a yellowish fluid, containing bits of necrotic tissue. Deep to the cyst a firm nodule of carcinoma, measuring approximately 1.5 cm. in diameter, was discovered and removed. Radical extirpation of the carcinoma and of the margin of edematous and necrotic brain surrounding it was carried out. The patient tolerated the procedure well, and postoperative convalescence was uneventful. The neurologic deficit was temporarily increased by operation, and the patient was unable to move either the left leg or the left arm. Spasticity in both these extremities was greatly increased. Return of function, however, began in the upper and lower extremities about two weeks after craniotomy. On January 20, five weeks after admission, the patient was transferred to the service of thoracic surgery.

Since the presenting neurologic symptoms were of a precise localizing nature, there was a definite possibility that only a single intracranial metastatic lesion was present and that this had been, so far as could be determined, completely removed. Furthermore, there was no evidence of metastases elsewhere, nor was there evidence of direct extension of the primary lesion to adjacent mediastinal structures. Accordingly, it was felt that pneumonectomy might offer a chance of cure.

Pneumonectomy was performed on January 22, and a fairly well circumscribed tumor of the upper lobe of the right lung, was encountered. No extension to the mediastinum was present, and no enlarged peritracheal nodes were observed. The subcarinal lymph nodes were dissected away with the lung and did not appear, grossly, to be involved.

Recovery from the pneumonectomy was prompt and uncomplicated. At the time of writing, five months after the last operation, a report on the patient's condition was made by his local physician. Although there was residual spastic paresis of the left leg, no evidence of recurrence of either the pulmonary carcinoma or the cerebral metastasis was apparent.

The report of the pathologic examination of the intracranial lesion was metastatic adenocarcinoma.

The pulmonary lesion proved on microscopic examination to be bronchogenic carcinoma. The subcarinal lymph nodes were not involved by carcinoma.

Comment.—It is felt that this case illustrates some of the major considerations which are of importance in formulating an attack on such a problem. The first of these, of course, is a careful evaluation of the patient's general condition, in an attempt to avoid operating on a person with diffuse metastatic disease. Because of the well known fact that it is possible for carcinoma of the lung to remain unsuspected over a long period, there is great danger that the surgeon will see the patient when metastatic disease is already widespread and out of any possible control. This type of patient is unsuitable for any operative intervention.

When it has been determined, as nearly as possible, that there are only two lesions, one in the brain and the other in the lung, the problem of whether craniotomy or thoracotomy should take precedence must next be considered. Carcinoma of the lung does not often kill rapidly

as the result of an increase in the growth of the primary lesion. Indeed, it is not uncommon for the tumor to remain practically asymptomatic unless there is infection within or distal to it. On the other hand, the patient cannot tolerate a rapidly expanding intracranial lesion for more than a short time. Further, carcinoma of the lung can grow slowly over a long period. For this reason, even though the primary lesion in the lung should subsequently prove to be irremovable, the patient may be given a degree of palliation by removal of the intracranial metastasis. This is worth while if the primary lesion is relatively asymptomatic and the neurosurgical procedure is not in itself crippling. On the other hand, if the tumor in the lung should prove to be removable and the metastatic lesion irremovable, death will inevitably ensue rapidly, and the patient will have been put through an unnecessary operation. For these reasons, it is believed the craniotomy should be the first procedure to be performed, as in the case just described.

Before final decision is made that craniotomy should be carried out, every effort should be made to localize the intracranial lesion and to determine whether it is made up of one focus or of multiple metastatic foci. That the latter is more probable is well illustrated by a series of 100 cases of carcinoma of the lung with autopsy reported by King and Ford.[7] Metastatic deposits in the nervous system were observed in 27 of these cases. Of these 27 cases, metastases were multiple in 20 and single in only 7. These authors made the interesting comment to the effect that the multiple lesions varied widely in size, as though of different ages. It must be remembered that in these cases autopsy was performed in the terminal stage of carcinoma, when multiple metastases may be presumed to have occurred. It might be assumed that had operative intervention been carried out early the surgeon would have found one metastasis.

Evidence of a single intracranial metastatic lesion adduced by the general neurologic examination is often unreliable. Metastases may exist in silent areas of the brain and give no indication of their presence. The ventriculogram offers by far the most reliable, although not too certain, diagnostic means for the demonstration of multiple metastases.

At craniotomy every attempt must be made, of course, to remove all the metastatic tumor. As a general rule, the nerve tissue immediately surrounding the metastasis is abnormal in that it is edematous, and often necrotic. The margin of damaged brain surrounding the metastasis usually can be sacrificed with the knowledge that the already existing neurologic deficit will be increased little, if any.

---

7. King, A. B., and Ford, F. R.: A Clinical and Anatomical Study of Neurological Conditions Resulting from Metastases in the Central Nervous System Due to Carcinoma of the Lung: Review of One Hundred Cases, Bull. Johns Hopkins Hosp. **70**:124-156, 1942.

After craniotomy the surgeon is again faced with a dilemma. At this stage the patient may present such a grave neurologic deficit that an attempt to prolong his life by pneumonectomy or lobectomy seems unjustified. Such a patient, however, often makes a remarkable recovery, and if one waits for this recovery to manifest itself the chance to remove the primary lesion may be lost.

The subject of the surgical attack on metastatic cancers is usually greeted with pessimism. There is, however, a growing body of evidence which reveals that in many cases life can be prolonged or cures obtained by a vigorous attack on the primary carcinoma or sarcoma and the distant metastatic lesions. This is amply illustrated by Alexander and Haight,[8] who collected a series of 24 cases in which pulmonary resection of solitary metastatic pulmonary neoplasms resulted in 16 per cent of five year "cures" and in 20 per cent of four year "cures." The present case, we feel, is another instance of the growing tendency toward vigorous surgical attack on cancer in cases in which the prognosis is apparently hopeless, but in which there is an excellent chance of palliation and a more remote chance of cure.

SUMMARY

A case is presented in which a combined surgical attack was made on a primary bronchial carcinoma and its apparently solitary cerebral metastasis. It is believed that craniotomy is indicated when clinical observations indicate the presence of only one, well localized intracranial lesion, whether or not the primary tumor can be removed; it is further believed that this procedure should precede the attack on the primary neoplasm. Craniotomy may be indicated as a means of palliation when the carcinoma of the lung is asymptomatic, even though the primary lesion is not resectable. Pneumonectomy should be reserved for those cases in which cure, rather than palliation, seems attainable. It is hoped that the report of this case will be followed by others of a similar nature, in order that such a combined attack may be properly evaluated.

319 Longwood Avenue, Boston.
University of Michigan.

8. Alexander, J., and Haight, C.: Pulmonary Resection for Solitary Metastatic Sarcomas and Carcinoma, Surg., Gynec. & Obst., to be published.

PROGRESS IN ORTHOPEDIC SURGERY FOR 1946

A Review Prepared by an Editorial Board of the American Academy of Orthopaedic Surgeons

IV. FRACTURE DEFORMITIES

HIP FRACTURES

Prepared by

LEONARD T. PETERSON, M.D., WASHINGTON, D. C.

REICH[135] summarized the treatment of ununited fracture of the femoral neck by various methods of osteotomy and reconstruction. The principle of treatment depends on the viability of the femoral head. Osteotomy or bone graft requires a viable head with suitable joint surface. If the head is necrotic, its removal is indicated. In such an instance arthrodesis or a Whitman or a Colonna reconstruction operation may be performed. Fixation of the osteotomy site with a Blount type of blade plate requires more extensive operation but eliminates the need for a cast.

[ED. NOTE:—The author, recognizing that these materials may act as undesirable foreign bodies, suggests that plates and screws "are potentially productive of postoperative infection."]

Speed[136] reviewed the treatment of fractures of the femoral neck and the technic of osteotomy for nonunion. He uses a guide pin. The osteotomy is performed above the lesser trochanter, and a spica is applied after operation. The procedure is not advised if the head has undergone necrosis. Ten cases are reported. There was 1 fatality (ten weeks after operation); the other operations were all successful.

[ED. NOTE:—A good presentation of this subject.]

Hall and Berg[137] report the results of trochanteric osteotomy in 14 patients with nonunion of the femoral neck of three to twenty-two months' duration. The length of the follow-up period and the criteria used are not stated, but results are reported as good or excellent in a high proportion of cases.

---

135. Reich, R. S.: Collective Review: The Treatment of Ununited Fractures of the Neck of the Femur, Internat. Abstr. Surg. **83**:105-112, 1946.

136. Speed, K.: Subtrochanteric Osteotomy for Ununited Fracture of the Neck of the Femur, Ann. Surg. **124**:576-585 (Sept.) 1946.

137. Hall, C. L., and Berg, C.: Osteotomy for the Treatment of Ununited Fracture of the Femoral Neck, J. Internat. Coll. Surgeons **9**:20-25 (Jan.-Feb.) 1946.

King[138] calls attention to the high mortality rate and the slow union in fractures high in the femur. Although nonunion is rare in comparison with intracapsular fractures, coxa vara is common. He advises open fixation with a nail plate. Particularly significant is his warning against internal rotation of the limb for reduction of the fracture at the time of fixation since the proximal fragment is externally rotated about 45 degrees. Reduction is facilitated if the distal fragment is permitted to rotate into this position. A combination of the Smith-Petersen nail and a plate is used for fractures and osteotomies. In addition, iliac bone chips are packed into a gutter at the site of nonunion or fracture. Seven out of 120 osteotomies had resulted in nonunion by the usual methods of treatment. He advises combined nailing of the femoral neck fracture and subtrochanteric osteotomy, with the addition of a plate for fixation for fractures over four weeks old, especially in young persons.

[ED. NOTE:—An excellent article on this subject.]

Inclan[139] reviews results of the treatment of fracture of the femoral neck and discusses the anatomic, physiologic and pathologic factors involved. The Leadbetter "heel test" of reduction is not considered reliable. He uses two wires to hold the head during nailing. The series included 84 recent fractures, 18 delayed fractures, 5 fractures in which there was neck absorption and 24 in which there was nonunion. Of 47 patients treated with the Smith-Petersen nail (which he prefers for metallic fixation) 81.8 per cent exhibited union when observed after one year or more; the rest had nonunion, necrosis, arthritis or ankylosis. Of 21 operations, including some on older patients, in which graft alone or graft and nail were used, 90.5 per cent were successful. Inclan recommends the latter method for use in cases of fresh subcapital fractures and in any case in which there is early tendency toward necrosis. He uses refrigerated graft (since 1940), either autogenous or homogenous; the incidence of each is not stated.

[ED. NOTE:—This article is well illustrated and should be read in full.]

Henderson[140] reports additional cases in which fibular bone graft was carried out for nonunion of the femoral neck, adding 22 cases to

---

138. King, T.: Slowness and Failure of Bony Union After Fractures and Osteotomies of the Proximal or Trochanteric End of the Femur, Australian & New Zealand J. Surg. **15**:33-48 (July) 1945.

139. Inclan, A.: Late Complications in Fracture of the Neck of the Femur Treated by Nailing, Bone Grafting or Both, J. Internat. Coll. Surgeons **9**:36-49 (Jan.-Feb.) 1946.

140. Henderson, M. S.: The Fibular Bone Graft in Ununited Fractures of the Neck of the Femur, Tr. West. S. A. (1944) **52**:583-595, 1945; West. J. Surg. **53**:422-426 (Dec.) 1945.

a series of 77 reported in 1940. A viable head is essential for this procedure. In 88 per cent of his series the operation was successful (previous series, 69 per cent). No deaths and no complications were encountered.

Bone grafting for nonunion of the femoral neck requires a reasonable amount of neck and a viable head. Henderson[141] reports 90 cases at the Mayo Clinic from 1913 to 1945, which represents about one tenth of all cases of similar nonunion observed during that time. The operation may be intra-articular or extra-articular, the latter method having been preferred since 1936. It is more suitable in an older age group than the former method. Tibia was used as graft in 24 cases, fibula in 67 and both tibia and fibula in 1. The fibula is preferred and is applied over a guide wire after the cortex is thoroughly roughened. Early results were only 33 per cent successful; later results were successful in 81 per cent of the cases that could be followed.

[ED. NOTE:—An excellent article.]

Rodo[142] reviews the problem of nonunion of the femoral neck, including the technic and the opinion of various authors. He presents 1 case in which a slight modification of various methods was used.

Esser [143] advises the insertion of the lesser trochanter into the acetabulum for reconstruction of a hip when loss of the head and neck of the femur has occurred. This requires a position of extreme external rotation and abduction. He cites a case involving a tabetic patient, but no roentgenograms are presented, and the follow-up report is incomplete.

[ED. NOTE:—This seems like a poor functional position. It is difficult to evaluate the method from the brief report, but it seems to compare unfavorably with fusion.]

BONE GRAFTS

Moore[144] reports 12 cases of pseudoarthrosis in children, in 8 of which it was of the congenital type. He uses a delayed method of bone grafting, freeing the graft and replacing it for a period of three weeks before transferring it to the other tibia. Postoperatively he fixes the

141. Henderson, M. S., and Henderson, E. D.: Bone Grafts for Ununited Fracture of the Neck of the Femur: A Report of Ninety Cases, J. Internat. Coll. Surgeons **9**:26-35 (Jan.-Feb.) 1946.

142. Rodo, A.: Pseudoarthrosis of the Neck of the Femur, J. Internat. Coll. Surgeons **9**:130-139 (Jan.-Feb.) 1946.

143. Esser, J. W. S.: New Method of Articulation of the Femur for Difficult Cases After Fracture of the Neck of the Femur, J. Internat. Coll. Surgeons **8**:512-513 (Nov.-Dec.) 1945.

144. Moore, J. R.: Pseudoarthrosis of the Tibia and Fibula in Children, J. Internat. Coll. Surgeons **9**:7-12 (Jan.-Feb.) 1946.

tibia with multiple pins at the upper and lower ends, incorporating the pins in plaster. Weight bearing is resumed after five months. Of the 8 operations for congenital disease, 6 were successful, 1 was followed by fracture and 1 failed. The author admits that the value of the delayed method is difficult to determine and that similar results might have been obtained by immediate transfer. He compares the delayed graft to os novum.

[ED. NOTE:—Os purum is preserved cortical or spongy animal bone. Os novum is new bone formed about os purum after the latter has been implanted under human periosteum, as in the tibia. The newly formed os novum is used elsewhere in the body at the site of bone graft. This method is used by Dr. Orell, of Stockholm, but is approved by few others.]

The principles of bone graft surgery are reviewed by Compton[145] in relation to nonunion of the long bones, spine fusion and arthrodesis of peripheral joints. He advocates the use of transverse processes as a source of bone in fusion of the thoracic spine and states that "50 per cent of spine fusions are of the dorsal spine." He advises tibial graft for rare nonunion of ribs.

[ED. NOTE:—The use of iliac bone appears to be more simple and to furnish a better source. The relative frequency of dorsal fusion is unusual. Since extensive rib resection is so common, it is questionable whether bone graft for nonunion of a rib is ever justified.]

Sarjeant[146] reports his experience with small iliac chip grafts measuring 1 by 0.5 by 0.2 cm. in a series of 12 defects of the long bones. Small grafts have the advantages of better nutrition and of tolerating infection better because they are viable. Since these grafts afford no fixation, other means of immobilization are required. The average time of grafting was two and a half months after injury. Infection recurred in only 1 case. He does not advocate the method for delayed union but feels it has a place in defects of the long bones. [ED. NOTE:—A good report on this method.]

Carpenter and others[147] describe the use of reenforcement grafts in instances in which the bone substance is insufficient for function. When these grafts are indicated, conservative treatment should not be prolonged. In a series of 52 cases, tibial bone was usually applied

145. Compton, H. T.: Bone Graft in Orthopaedic Surgery, J. M. A. Georgia **35**:112-115 (April) 1946.

146. Sarjeant, T. R.: Treatment of Defects of the Long Bones by Cancellous Chip Bone Grafts, Canad. M. A. J. **54**:119-124 (Feb.) 1946.

147. Carpenter, G. K.; Rosenfeld, R. T., and Mech, K. F.: Restoration of Bone Strength with Reinforcement Bone Grafts, J. Bone & Joint Surg. **28**:692-698 (Oct.) 1946.

and fixed with metal screws. The operation in all cases was successful, and there was only one recurrent infection, which responded to treatment. [ED. NOTE:—As the authors suggest, bone graft should be performed early when it is indicated.]

Luckey and Adams[148] review the principles of bone grafts, describing the types and the indications for their use. Bone drilling was not used in their series because cases which would require drilling are more suitable for grafting, and results are more certain. [ED. NOTE:—I concur with this opinion. Blind drilling is uncertain and may be dangerous. Open operation and drilling is not a satisfactory substitute for bone grafting.] They used iliac bone, supplemented in some cases with a rigid tibial graft, but tried to avoid the use of plates or screws alone. Strips of iliac bone were inserted in slots or applied as onlay grafts. The fibrous tissue between the fragments was usually removed, but union was also satisfactory where this was not done. Iliac bone was used for arthrodesis of wrist, knee and subtalar joint. They report 228 cases, 164 of nonunion and 64 of arthrodesis.

There was recurrent infection in 22 cases, but firm union occurred in 17 of these. There were only 13 cases in the series in which the procedure failed; in several of these the patient was cured by a second operation. [ED. NOTE:—A good record for war casualties. In this total series tibial bone was used more often than iliac bone, although the title refers only to the latter.]

Terhune and Gill[149] review their experience in an army general hospital in the care of war casualties with defects in the long bones. In 14 cases of tibial defect they transplanted the fibula above and below in two stages, obtaining union between tibia and fibula at one site before proceeding to the second stage. In 1 case sufficient union occurred for weight bearing, but in the others additional bone graft was required. The procedure is advised as an early measure in preparation for subsequent grafting when the defect is large. In some instances of tibial defect and in all femoral defects dual tibia grafts were used, with additional bone from the ilium when necessary. They recommend postoperative immobilization by skeletal traction rather than cast in cases in which the femur is involved. [ED. NOTE:—A good point.] There were 16 cases in which bone graft of radius or ulna was performed; in some there was replacement of as much as a 6 inch (15 cm.) defect with a fibula graft, step cut and fixed with metal screws. The results were good.

---

148. Luckey, C. A., and Adams, C. O.: The Use of Iliac Bone in Bone-Grafting and Arthrodesis, J. Bone & Joint Surg. **28**:521-534 (July) 1946.

149. Terhune, S. R., and Gill, G. G.: Graft Substitution of Long Bone Shaft Defects, South. Surgeon **12**:118-129 (Aug.) 1946.

Successful dual bone graft of the humerus is reported by Lucas and Gill[150] in a case in which operation was performed four months after drainage. The defect was obliterated by opposing the separated ends and shortening the humerus. Tibial grafts were applied.

A varied series of bone grafts for war injuries is reported by Snedecor and Coffey.[151] Experiences and illustrative cases are presented. They advocate immobilization in extension and supination after grafting of the proximal end of the ulna.

[ED. NOTE:—It is better to fix the graft adequately and put in flexion and mid-rotation.]

Brown[152] refers to Mowlem's work (1941) on the viability of cancellous bone, which is considered to remain alive for a longer period than cortical bone. He then reports excision of three extraperiosteal tumors, two of the radius and one of the phalanx, followed by insertion of cortical bone. He concluded that these grafts survived without undergoing necrosis and substitution. [ED. NOTE:—The evidence is still not conclusive on this disputed point.]

Dick[153] briefly reviews the history of bone grafting and cites the advantages of iliac bone for grafting and for arthrodesis. Representative cases are presented with illustrations. [ED NOTE:—This is a good article, and it confirms numerous other opinions on the advantages of iliac bone.]

Hoyer[154] reports the use of bone dust suspended in plasma to form a paste in the regeneration of the rabbit's fibula. The mass of regenerated bone was greater than when bone chips or periosteum alone was used. The possible applications in orthopedic surgery are discussed. [ED. NOTE:—The author does not state how many animals were used. This principle increases the possibilities of preserved bone and bone banks.]

MISCELLANEOUS FRACTURES AND BONE REPAIR

Sommervell,[155] after twenty-two years of experience in India, discusses treatment of malunited fractures encountered there. He states

150. Lucas, L. S., and Gill, J. H.: The Use of a Dual Onlay Graft and Penicillin in an Infected Bone Defect: Case Report, West. J. Surg. **54**:18-20 (Jan.) 1946.

151. Snedecor, S. T., and Coffey, F. L.: Bone Grafts in Non-Union of War Fractures, Am. J. Surg. **71**:577-586 (May) 1946.

152. Brown, D.: Survival of Cortical Bone After Bone Grafting, Brit. M. J. **1**:389-391 (March 16) 1946.

153. Dick, I. L.: Iliac-Bone Transplantation: Preliminary Observations, J. Bone & Joint Surg. **28**:1-14 (Jan.) 1946.

154. Hoyer, L. J.: The Acceleration of Bone Production by Use of Ground Bone, Minnesota Med. **29**:328-329 (April) 1946.

155. Sommervell, T. H.: Malunited Fractures and Dislocations, Indian J. Surg. **7**:85-95 (June) 1945.

the essential principles which apply to various bones and joints, with particular emphasis on adequate immobilization of the fracture and early mobilization of the joints. He writes that shortening up to 2 inches (5 cm.) in the femur "does not matter" and that "plates *always* get loose in a few weeks."

[ED. NOTE:—The former statement should not be accepted as a good standard; the latter, unfortunately, is too often, and unnecessarily, true.]

Sutro[156] presented 8 cases of mild ossification about the ankle after sprains in which painful symptoms were persistent. He compared this change to post-traumatic ossification of the tibal collateral ligament. Treatment is symptomatic.

Snedecor[157] reviews the types of injuries of the ankle and foot incurred in war. Pain associated with destruction of the joints is the usual indication for arthrodesis. The patients were usually given the test of weight bearing before fusion was done.

[ED. NOTE:—The incidence of failure of the operative procedure is not given.]

Scott[158] reports a case of nonunion of a large fragment of the left ischium due to failure of fusion of an ossification center. The patient also had deformity of the spine due to adolescent epiphysitis. The ischial lesion was asymptomatic and did not require treatment.

Caldwell[159] reviewed the pathologic changes characteristic of osteomyelitis of hematogenous and traumatic origin. He reported on 43 cases almost equally divided between the two types in which treatment consisted of surgical débridement and attempted closure with skin and, in some cases, muscle. The wound healed in approximately 90 per cent of the cases, and in 60 per cent it remained healed. The results were comparable for both types.

Engstrom and Orell[160] conducted experiments on living animal bone to determine the effect of drilling or polishing with high speed burrs. They found that the high speed caused an actual burning of the tissues which retarded the regeneration of bone. Slow speed or measures to cool the area decreased the harmful effects. The connective tissue in burned bone was likely to be devoid of osteoid tissue.

---

156. Sutro, C. J.: Para-Articular Ossification of the Soft Parts of the Ankle: Complication of Sprain With or Without Fracture of the Shaft of the Ipsilateral Fibula, Arch. Surg. **53**:441-447 (Oct.) 1946.

157. Snedecor, S. T.: Reconstructive Surgery in Patients with War Fractures of the Ankle and Foot, J. Bone & Joint Surg. **28**:332-342 (April) 1946.

158. Scott, W.: Non-Union of the Ischial Tuberosity Associated with Epiphysitis Vertebrae, J. Bone & Joint. Surg. **28**:862-864 (Oct.) 1946.

159. Caldwell, G. A.: Repair of Bone Defects Associated with Osteomyelitis, Tr. South. S. A. (1945) **57**:236-239, 1946.

160. Engstrom, H., and Orell, S.: Regeneration in Bone Defects After Polishing with Metal Burrs, Acta oto-laryng. **29**:337-347, 1941.

A FEW HISTOCHEMICAL CONSIDERATIONS RELATIVE TO BONE GROWTH AND REPAIR

Prepared by

C. GLENN BARBER, M.D., CLEVELAND

Histochemical Considerations.—Recently there have appeared some interesting and enlightening reports of studies on the histochemical changes which occur in bone growth and repair. Wolbach,[161] in an article entitled "Vitamin A Deficiency and Excess in Relation to Skeletal Growth," commences with an interesting and concise reiteration of a few of the fundamentals of skeletal growth and development. Bone constantly undergoes continuous remodeling and extreme lability throughout life, rapidly during growth and more slowly thereafter, and because of this and similar responses common in pathologic conditions, it is an exceedingly labile tissue. The agents that cause resorption of bone are multiple. All vitamin deficiencies which culminate in severe malnutrition (and most of them do) arrest bone growth. There are three vitamins, A, D and C, which directly affect bone growth. Vitamins A and D are specifically involved in activities of epiphysial cartilage cells. When there is vitamin C deficiency in growing animals, bone suffers in common with all collagenous structures. Convinced that vitamin A is unique because it is the only vitamin which when given in quantities greatly in excess of normal requirements actually accelerates some normal growth sequences, Wolbach endeavors to show quantitative relationship to the amount of vitamin A administered. Vitamin A deficiency suppresses epiphysial cartilage sequences, and an excess accelerates them, and when the excess is considerable it results in dramatic and disastrous consequences on bone. In instances of vitamin A deficiency all epiphysial cartilage sequences cease. Cells cease to divide, and those which have reached almost mature size undergo no further change. Only those cells which have progressed to the vesicular stage continue to change and finally disappear, permitting vascular penetration. The cartilage trabeculae calcified before the deficiency was established are resorbed by osteoclastic action. The matrix of the now atrophic epiphysial cartilage becomes densely calcified for a depth of a few cells on the diaphysial border, and eventually a thin bony plate is formed across the face of the epiphysial disk.

The author points out that the resulting appearance is similar to that produced by inanition from inadequate amounts of a perfect diet or by inanition resulting from deficiencies of other vitamins not specifically related to bone growth, such as riboflavin and pyridoxine. However, when there is inanition from these various causes the growth

161. Wolbach, S. B.: Vitamin A: Deficiency and Excess in Relation to Skeletal Growth (Ludvig Hektoen Lecture), Proc. Inst. Med. Chicago **16**:118-145 (April 15) 1946.

of all tissue is correspondingly retarded, whereas in vitamin A deficiency growth of enchondral bone ceases before the rate of growth of the animal as a whole is seriously affected. The disastrous consequences in the central nervous system of this disparity of growth of the skeleton and the soft tissues in experimental animals is pointed out, and it is noted that the cessation of growth of enchondral bone is not the whole story of the effect of vitamin A deficiency on young bones. Remolding ceases, and appositional bone formation continues at different rates in locations which vary with the species but which are in conformity with each normal growth pattern. The long bones of animals with vitamin A deficiency are shorter and thicker than those of normal animals. The shortness is the result of failure of growth of enchondral bone. The increased thickness is produced by continued appositional bone growth and, near the ends of the bones, by the retardation of remodeling sequences in the final period of growth before complete deficiency is established.

[ED. NOTE:—This is an article which should be read by orthopedic surgeons and others interested in the growth and development of bone as well as in its pathologic changes. A number of objections to the conclusions deduced from the material presented concerning vitamin A deficiency and excess in relation to skeletal growth will be found by many who read the article; such as may be pointed to could be multiplied and the article would still be a splendid one.]

Swenson and Claff,[162] in studies on the p_H of the clot formed at the site of induced fractures in dogs, found that there was an initial local acidity which was followed by a change to alkalinity beyond the value in the venous blood. Similar results have been reported by others. Exponents of one theory of calcification postulate that there is initially a high concentration of calcium ions at the fracture site because of the increased solubility of the bone calcium salts in the acid hematoma fluid and since calcium salts are less soluble in an alkaline medium a precipitation of calcium takes place as the hematoma becomes alkaline and repair progresses.

In what appears to be an extended report of the preceding work by Swenson and Claff, Swenson [163] attempts to correlate the p_H and the inorganic phosphorus and alkaline phosphatase contents. Biopsies were made to determine the degree of calcification. In six of eight fractures there was definite calcification, and in two others there was questionable calcification. There was no demonstrable calcification in a series of six fractures, in which material for biopsy was obtained before there was an elevation in the alkaline phosphatase content.

---

162. Swenson, O., and Claff, C. L.: Changes in Hydrogen Ion Concentration of Healing Fractures, Proc. Soc. Exper. Biol. & Med. **61**:151-154 (Feb.) 1946.

163. Swenson, O.: Biochemical Changes in Fracture Hematoma, J. Bone & Joint Surg. **28**:288-293 (April) 1946.

Munro and Chalmers [164] have shown that in the presence of experimental fractures in rats there is an increase in the output of urea and other nitrogenous substances in the urine. Such increases have been found after different types of injuries by other investigators. They found that this loss of nitrogen cannot be completely suppressed by feeding a diet high in protein and calories. They observed the nitrogen output to be slightly raised after fracture when the animals were on a nonprotein diet, rather more when they were on a 10 per cent protein diet and still more when they were on a 25 per cent protein diet. They found it difficult to explain the nitrogen loss as being due merely to destruction of local tissue and atrophy at the site of injury. Labial cytoplasm temporarily stored in the liver and possibly in other tissue reserves seemed to them a more logical explanation for the increased urinary nitrogen than the raiding of tissues for essential amino acids.

Cretin [165] reiterates the concept that the cartilage represents one stage in the development of enchondral bone. Cartilagenous fragments are frequently found in experimental fractures in small laboratory animals. Likewise in cases of nonunion or pseudarthrosis in human beings formation of cartilage at the site of the false joint usually occurs.

The present day concepts of histologic phases of cartilage and bone regeneration are reviewed. An attempt is made to present the problem from a histologic and chemical basis. The shortcomings and disadvantages of such an approach to the subject are recognized, but the advantages are worthy of consideration. The important point is that the problem is related to protein. The cartilage in the long bone is a reservoir of protein material which permits ossification to be slowed down or discontinued. A whole assortment of indiscernible factors enter the problem, such as the combination of chondrin and collagen elements, in which calcium, phosphorus, phosphatase, sulfur, iron and related material all play their role. The loss of sulfur is the phenomenon which precedes the transformation of cartilage. A powerful anticoagulating agent resembling heparin interferes with the conversion to bone. There is a temporary stopping or slowing down in the normal proces of repair, and the chondrolyse which forms at the termination of the fibrinous tissue is an indication of a definite arrest of normal ossification or of an interference with it and results in pseudarthrosis. The important phase in the problem is the combination of the chondrin and the collagen elements.

---

164. Munro, H. N., and Chalmers, M. I.: Fracture Metabolism at Different Levels of Protein Intake, Brit. J. Exper. Path. **26**:396-404 (Dec.) 1945.

165. Cretin, A.: Cartilaginous Formations in Callus of Experimental Fractures, Presse méd. **54**:74-75 (Feb. 2) 1946.

Howard, Parson and Bigham [166] present a detailed accounting of studies made on the movement of calcium and phosphorus, with especial attention to the amounts and concentrations of these elements in the urine in 17 patients confined to bed with complete leg casts and partial body casts. Thirteen patients had suffered femoral or tibial fractures. Four patients were studied before and after femoral osteotomy was performed for slipped epiphysis.

Their interest in the subject had been incited by several reports of a high incidence of stones in the kidneys and bladder in patients convalescing from skeletal injuries in service hospitals. In a most enlightening, thorough and orderly manner, the results of their studies, which were unusually controlled, are fully presented. Control studies such as the determination of the water and nitrogen balance, the calculation of the dietary content, regular analyses of every blood constituent which might in any conceivable manner bear a relationship to probable variations from the normal, all of which are essential in a study of this kind, were painstakingly done.

The methods and types of analyses are outlined. The dietary factors, the relationship of urinary phosphorus to the protein catabolism reaction and the concentration of inorganic phosphorus, alkaline phosphatase and calcium in the serum are separately considered. Plotted on two charts and individually recorded in eight well arranged charts, the results of the studies on the 17 patients included in their thesis are adequately expressed.

They found a steady rise in the urinary content of calcium, which reached its maximum approximately one month after injury; it remained at that level for a variable period and then declined in a strikingly similar pattern. The maximal excretion of calcium was reached in every instance at a time when the protein catabolism reaction had waned and nitrogen equilibrium was approximated.

Alterations in the diet and the administration of a variety of drugs including vitamin D and alkalis resulted in negligible alterations in the urinary calcium level. The variations in the inorganic phosphorus content in the urine were in general much wider than the variations in calcium and were found to be more susceptible to change as the result of dietary shifts. The urinary phosphorus level invariably reached a peak at the height of the protein catabolism reaction and thereafter gradually fell, paralleling the nitrogen level in the urine.

The possible relationship between the blood supply to the immobilized part and the pattern of urinary calcium excretion is discussed. In only 2 of the patients studied (aged 14 and 17 years) were there

166. Howard, J. E.; Parson, W., and Bigham, R. S., Jr.: Patients Convalescent from Fracture: Urinary Excretion of Calcium and Phosphorus, Bull. Johns Hopkins Hosp. **77**:291-313 (Oct.) 1945.

any signs or symptoms suggestive of nephrolithiasis. Red blood cells and calcium casts appeared in the urine of 1 patient during the administration of calcium lactate. No pain was experienced, and the abnormal elements in the urine promptly disappeared when the administration of calcium lactate was discontinued. The other patient had frank renal colic, with red blood cells in the urine. The symptoms promptly disappeared when fluids were forced. Urography revealed no evidence of stone in either of these patients with renal symptoms.

[ED. NOTE:—It should always be remembered that bodily functions are ever dependent on constantly variable needs, that the vital forces attempt, with surprising success, to maintain an equilibrium among the demands of the various elements relative to the intake, utilization and output, that the blood is the conveyer which carries constituents to and away from the places where they are used and that calcium is mostly eliminated through the bowel and phosphorus through the kidney.]

Since stones in the kidneys and bladder are commonly found in patients who have suffered injury or damage to the spinal cord, it would be of interest to know how many of the patients with urinary calculi in the report from the service hospitals which incited this investigation had suffered such damage.

Levander and Willstaedt [167] report that at the time of writing they were engaged in a more detailed investigation of the chemical nature of an osteogenic substance which can be extracted from bone tissue with alcohol. Levander, Annersten, Berteken, Lacrost and others have previously reported on the same material. The authors are desirous of showing, by experiments in collaboration with D. Hans Bohr, that the osteogenic substance can be shaken out from its alcoholic solution with benzene. Furthermore, by saponification the lipid substance in the bone marrow can be divided into (*a*) the unsaponificable fraction, (*b*) the fatty acid fraction and (*c*) the residual solution. The osteogenic activity in fraction *a* was low, in fraction *b* somewhat higher and in fraction *c* completely inactive.

Operative Procedures on Fractures and on Bony Defects.—Hicks [168] cites 11 cases, presenting brief records and roentgenograms, and advocates the radical excision of all infected tissues including bone and the application of metallic internal fixation in a single stage operative procedure for the management of chronically infected, ununited fractures. He states that the method is not an established one and is subject to considerable diversion of opinion.

---

167. Levander, G., and Willstaedt, H.: Alcohol-Soluble Osteogenetic Substance from Bone Marrow, Nature, London **157**:587 (May 4) 1946.

168. Hicks, F. G.: Single Stage Operative Method of Management of Chronically Infected Ununited Fractures, Surg., Gynec. & Obst. **82**:44-52 (Jan.) 1946.

Details of the preliminary procedures, which include chemotherapy, the operative technic, postoperative care and observations, together with some roentgenograms are presented. It is interesting and important to note that several patients who were allergic received no chemotherapy and all did well.

In summarizing, he states that healing of bone and soft tissue after this procedure compares favorably with healing after fresh fracture and also that the cessation of local infection and dissemination is noted. The shortening of limbs is minimal, and rehabilitation is hastened. The patients were members of the Canadian Armed Forces, and although their ages are not stated it is inferred that they were adults. The time at which operation was performed varied from three months to two years after the injury. In some of the cases the metal plates were removed and the site inspected. No evidence of infection was observed, and afterward the sites of the screw holes healed promptly.

Old Fracture of the Mandible.—Barsky [169] advocates what he terms the molded bone graft for the restoration of contour in plastic surgery. Shavings 2 or 3 mm. thick and as long as a previously prepared wax pattern are taken from the crest of the ilium. Pieces of cancellous bone not more than a few millimeters long are also obtained from the ilium. The prepared defect is packed with cancellous bone fragments and the bone shavings inserted over them. The skin is closed and a malleable lead mold cushioned with stent or dental molding compound is placed over the restored defect and held in position with elastic adhesive.

Blocker and Weiss [170] briefly summarize the history of bone grafts for the repair of fractures and defects of the jaws, principally fractures of the mandible. Of a group of 339 patients with defects of the mandible sent to a center for plastic surgery, 43 required the grafting of bone to bridge defects varying from 3 to 12 cm. in length. Added to the 43 patients with mandibular defects were 9 patients with defects of the maxilla, in all of whom cancellous bone grafts from the ilium were successful.

The grafts consist of cancellous iliac bone from which the cortical bone has been removed so that the graft may easily be cut with scissors to fit perfectly in the defect.

Describing their plans of treatment, operative technic and postoperative care, they also point out that infection should be eliminated, sequestra and fragments of broken teeth removed and soft tissue defects remedied before bone grafting is attempted.

---

169. Barsky, A. J.: Molded Graft, Surgery **18**:755-763 (Dec.) 1945.

170. Blocker, T. G., Jr., and Weiss, L. R.: Use of Cancellous Bone in Repair of Defects About Jaws, Ann. Surg. **123**:622-638 (April) 1946.

[ED. NOTE:—Iliac bone has been the source of grafts for defects of the mandible for more than twenty-five years. It is questionable whether it is essential to use only cancellous iliac bone. However, it is necessary when using iliac bone with cortex not to bolt it in but to lay it in, relying on external splinting for fixation.]

Cashman [171] restates some of the essential factors projected in three authoritative texts concerning the normal repair of bone and cites the references. He then stresses the importance of strict attention to mechanical and local factors. Poor apposition and failure to secure early complete immobility and infection he concludes are the chief causes of delayed mandibular union.

Inclan [172] presents a case in which there was absence of the right half of the body of the lower jaw bone due to surgical removal of a tumor. Treatment was by means of a rib graft; a maxillary splint of Haynes for maintaining immobilization during fifteen weeks was employed. By the end of this period, bony union was present. The Haynes splint offers the advantage of permitting chewing and oral hygiene in such cases; furthermore, it insures complete immobilization of the graft up to the time of bony union.

Lazansky and Wuehrmann [173] report on a 24 year old dental student who sustained two simple fractures of the mandible, one at the angle on the left side and the other between the lower right cuspid and the lateral incisor. Intermaxillary wiring was applied eleven days after the injury and allowed to remain in situ for fifty-one days. On removal of the wire, the fracture at the mandibular angle was healed, but the other one was still ununited. Eighteen days later a split acrylic splint for the lower teeth was applied. One and one-half months later the second fracture showed evidence of healing.

Müller [174] reports a case in which bilateral dislocation of the mandible of three months' duration was finally reduced after several unsuccessful attempts by prolonged pressure in a downward and inward direction on one side at a time.

Rehabilitation and Evaluation of Disability in Orthopedic Surgery.—Clarke [175] describes the organization and functioning of the Royal

171. Cashman, C. J.: Delayed Union of Mandibular Fractures, J. Oral Surg. **4**:166-171 (April) 1946.

172. Inclan, A., Jr.: Haynes Splint in Case of Bone Graft of Lower Jaw, Cir. ortop. y traumatol., Habana **12**:132-137 (July-Sept.) 1945.

173. Lazansky, J. P., and Wuehrmann, A. H.: Failure of Union in a Mandibular Fracture and Its Successful Nonsurgical Treatment, Am. J. Orthodontics **32**:182-183 (March) 1946.

174. Müller, G. M.: Long-Standing Dislocation of Mandible: Manual Reduction, Brit. M. J. **1**:572 (April 13) 1946.

175. Clarke, H. O.: Orthopaedic and Rehabilitation Service of Royal Air Force, Lancet **1**:721-723 (May 18) 1946.

Air Force's combined orthopedic rehabilitation service. It was born in the grim days of 1940, and credit for its origin and development is due to Sir Reginald Watson-Jones. It was supported strongly by the director general of medical services and his aides. The results obtained in the five year period 1941 to 1945, inclusive, were amazingly successful. During this period, 153,472 outpatients and 62,210 inpatients with major and often multiple injuries were treated. The success of the organization can be judged by the fact that 77 per cent returned to full duty, 18 per cent were retrained or returned to modified duties in the service and 4.8 per cent were invalided because of maximum disability or psychologic complications.

The importance of teamwork is stressed; i.e., the right man should be picked for the right job. Good surgical procedures and good rehabilitation are of equal importance. In order of their importance, the author elaborated on (1) mental rehabilitation, (2) physical rehabilitation and (3) technical rehabilitation.

Mech [176] presents some of the preoperative or preliminary problems to be considered and dealt with in reconstructive surgery when loss of tissue requires repair, compensation or replacement. The importance of débridement, chemotherapy and the replacement of lost or depleted blood elements by transfusons of whole blood or fractions of blood is cited. The importance of maintaining the water, protein, electrolyte and vitamin balance is also stressed. Hypoproteinemia and low vitamin C levels particularly retard or disrupt healing.

When these factors as well as the factor of infection are duly considered and made a part of reconstructive surgery, 95 per cent of the traumatic wounds received in war or industry can be secondarily closed in from four to ten days after injury. When it is properly instituted and thoroughly carried out, far better results can be obtained and more time saved by such a program than by the Trueta-Orr method, which was generally used at the beginning of World War II.

Rice [177] presents a number of dictums by which calculation of disability can be guided so that the injured person can be given the benefit of the doubt and the insurance carrier may feel that he is not being required to pay excessively. He points out the relative values of various single joints to the extremity involved and the combined values in multiple involvement of the joints. He also points out that the degree of motion is the most objective measurable factor and the one on which the legal status of the disability largely depends. Additional estimates of pain, loss of sensation and power must be considered, but

176. Mech, K. F.: Patient's Part in Reconstructive Surgery, Bull. School Med. Univ. Maryland **30**:185-191 (April) 1946.

177. Rice, C. O.: Calculation of Disability in the Extremities, Minnesota Med. **29**:160-164 (Feb.) 1946.

when the serviceable range of motion has been accurately evaluated most of the others have been given due consideration. Drawings, figures, formulas and equations of unquestionable value are presented. The article should be of intense interest to all who may frequently be called on to estimate disabilities in injured extremities.

Smith [178] attempts to present in a logical manner the principles of evaluation of disability as applied to injuries of the extremities. He points out the importance of obtaining a good history relative to past as well as the present injury. He considers and presents details of methods for measuring the length of the leg, testing ligaments and determining motion of the joints, impairment of nerves and the total function of the part. He appreciates the difficulties of presenting the entire field of evaluation of disability in an abstract manner.

De Lorimier, Minear and Boyd,[179] in a study of the records on 239 patients with diseases listed as osteoporosis, infectious arthritis, transverse myelitis, poliomyelitis, peripheral nerve injuries, tabes dorsalis and various neoplasms, present changes commonly seen in the roentgenograms which they regard as localized deossifications in the extremities. They depict four variants of their so-termed deossification: (*a*) discrete mottlings, (*b*) distinct bands, (*c*) deossifications beneath subchondral cortices and (*d*) diffuse mottling. They also list the etiologic factors under three general headings, i. e., (1) traumatic, (2) infectious and (3) neoplastic. Under these three general classes are ten subclasses.

Reproductions from illustrations in the monograph of Lexer, Kuliga and Turk showing the distribution of the vascular bed in the tibia, fibula and foot bones as well as reports on 5 of the cases included in their study are presented. The ideas presented by Sudick, Keinböck, Lariche and Policard and Greig are briefly mentioned.

[ED. NOTE:—Although this article may be of aid and interest to the radiologist in the interpretation of roentgenograms, it is difficult to correlate the material presented with the views which have been generally accepted from the work of Sudeck, Keinböck and Lariche and Policard.]

---

178. Smith, W. C.: Disability Evaluation of Injured Extremity, Northwest Med. **45**:33 (Jan.); 104 (Feb.); 178 (March); 258 (April) 1946.

179. de Lorimier, A. A.; Minear, W. L., and Boyd, H. B.: Reflex Hyperemic Deossifications Regional to Joints of Extremities, Radiology **46**:227-236 (March) 1946.

V. TUMORS OF BONE AND OF SYNOVIAL MEMBRANE

Prepared by

HENRY W. MEYERDING, M.D., and FORREST L. FLASHMAN, M.D.

Assisted by

JOSEPH M. JANES, M.D.; EDWARD L. FOSS, M.D.;
NORMAN R. BECK, M.D., Fellow in Orthopedic Surgery;
LUIS BRAVO, M.D., and JESSE P. CHAPMAN Jr., M.D., Fellows in Surgery
JOHN C. IVINS, M.D., and ARNULF R. PILS, M.D., Fellows in Orthopedic Surgery,
and
LUIS O. MEDEROS, M.D., Fellow in Neurology and Psychiatry
ROCHESTER, MINN.

SIMPLE BONE CYSTS

TAVERNIER [180] discusses simple bone cysts and states that they can be cured by relatively simple measures. He advocates curettage, followed usually by bone grafting in the cystic cavity. In several cases in which repeated fractures and rapid healing were followed by cysts, permanent healing and replacement of the cyst by normal bone were obtained by curettage and bone graft. Three cases were cited as examples. He points out that fractures through bone cysts are often characterized by rapid healing. Relapses, recurrence of bone cysts and refracture follow later. He states that healing of a fracture through a bone cyst does not constitute a cure.

[ED. NOTE.—As a rule fracture through a bone cyst with healing of the fracture does not always constitute a cure of the cyst, and other measures usually have to be taken, such as curettage and bone grafting. Measures such as the application of casts or splints are required to protect the grafts until the bone has gained sufficient strength to withstand normal stresses and strain. Furthermore, microscopic examination of tissue from these cysts should be a routine procedure.]

Janes [181] reports a case of localized bone cyst in the os calcis, which was treated by bone grafting, with recovery. The pathologist

---

From the Section on Orthopedic Surgery, Mayo Clinic.

The authors and their assistants are from the Mayo Clinic and Mayo Foundation, Rochester, Minn.

180. Tavernier: L'évolution des kystes des os, Lyon chir. **40**:666-668 (Sept.-Oct.) 1945.

181. Janes, J. M.: Localized Bone Cyst of the Os Calcis, J. Bone & Joint Surg. **28**:182 (Jan.) 1946.

reported osteitis fibrosa cystica. Copleman, Vidoli and Crimmings [182] present solitary cyst of the calcaneus in 3 cases. In 2 of these operation was performed and yellow fluid was encountered. The 2 patients complained of aching pain in the heel. Nine similar cases have been reported by others in the literature. Young adults have been affected chiefly, and their major complaint has been aching pain on walking.

Rushton [183] reports 3 cases of solitary cysts of the mandible and includes as criteria for the diagnosis of a solitary bone cyst (1) a single cyst, (2) no epithelial lining, (3) no evidence of infection, (4) fluid in the cyst and (5) walls of bone around the cyst. He reviews the literature and mentions theories of causation.

[ED. NOTE.—We have little knowledge of these cystic conditions in the mandible and need more data to formulate definite opinions.]

Schlumberger [184] reports 11 cases of fibrous dysplasia of the maxilla and the mandible. The maxilla was involved seven times and the mandible four times. Curettement or attempted excision of the lesion was the only treatment employed in these cases. The incidence of recurrence has not been determined. Schlumberger states that on clinicopathologic grounds the so-called ossifying fibroma of the maxilla and the mandible may be regarded as a variant of fibrous dysplasia.

OSTEOID OSTEOMA

Andersen [185] discusses 3 cases of cortical osteoma. In 1 case the lesion was in the left trochanteric region, in 1 at the upper end of the femur and in 1 in the middle part of the femur. The lesion of the midfemur followed what had apparently been a bone abscess subsequent to generalized furunculosis about two and one half years previously. Staphylococcus aureus was cultured from the bone abscess. Andersen summarizes the data on this case about as follows: A man 40 years old had an abscess of the left femur with pus after furunculosis. Culture disclosed Staph. aureus. At the same time a change appeared in the cortical tissue of the right femur, and a clear spot developed about two and a half years later. The patient was

182. Copleman, B.; Vidoli, M. F., and Crimmings, F. J.: Solitary Cyst of the Calcaneus, Radiology **47**:142-148 (Aug.) 1946.

183. Rushton, M. A.: Solitary Bone Cysts in the Mandible, Brit. Dent. J. **81**: 37-49 (July 19) 1946.

184. Schlumberger, H. G.: Fibrous Dysplasia (Ossifying Fibroma) of the Maxilla and Mandible, Am. J. Orthodontics **32**:579-587 (Sept.) 1946.

185. Andersen, K.: Er det corticale osteoid en form af osteomyelitis infectiosa? Nord. med. **25**:305-309 (Feb. 16) 1945.

nearly free of symptoms referable to the right femur at the beginning. The roentgenogram disclosed a lesion of the right femur that resembled a cortical osteoid osteoma. At operation there were no signs of infection and the microscopic picture was identical with that of a cortical osteoid osteoma.

Andersen states that it was natural to consider the furunculosis and the abscess of the bone in the left femur in direct connection with this new lesion in the right femur in that the cortical changes in the right femur may have been a complication following infection or inflammatory changes. The absence of inflammation in the clear space on histologic examination of the tissue probably prevents this from being considered an etiologic factor in the case.

Miller [186] reports a case of osteoid osteoma of the left astragalus in a white woman 18 years old. Biopsy had been performed seven months previously and the report of chronic inflammatory tissue received. At the time that the exploration was done the lesion was considered to be a burned-out bone abscess. Histologic examination of the tissue revealed an osteoid osteoma.

Palmer [187] reports a case of osteoid osteoma in a man, 32 years old, who gave a history of severe cutting pain in the anterior aspect of the right foot for four years. An osteoid osteoma was removed below the neck of the talus.

Voshell and Appleby [188] discuss briefly osteoid osteoma and present a case in which the lesion was in the proximal portion of the femur and was associated with an adjacent myositis ossificans in the psoas muscle. The patient was treated by surgical excision of the osteoid osteoma and of the area of myositis ossificans.

Campos [189] presents a case of osteoid osteoma in the fourth cervical spinous process of a white girl 11 years old. Relief was obtained by surgical excision of the spinous process.

Weeden and Oliva [190] report a case of osteoid osteoma of the ulna in which the lesion appeared in the roentgenogram as an area of

186. Miller, O. L.: Osteoid Osteoma, Bull. Charlotte Mem. Hosp. **2**:37-39 (Sept.) 1946.

187. Palmer, I.: A Peculiar Bone Tumor: Case Report of a Condition Described Previously in the Literature Under the Name Osteoid-Osteoma or Corticalis Osteoid, Acta chir. Scandinav. **92**:387-392, 1945.

188. Voshell, A. F., and Appleby, G. S.: Osteoid-Osteoma Associated with Myositis Ossificans: Case Report, Bull. School Med. Univ. Maryland **30**:140-143 (Jan.) 1946.

189. Campos, O. P.: Osteoid-Osteoma of Cervical Spinous Process: Report of a Case, J. Internat. Coll. Surgeons **9**:112-115 and 129 (Jan.-Feb.) 1946.

190. Weeden, W. M., and Oliva, J. J.: Osteoid Osteoma, Am. J. Surg. **71**: 558-559 (April) 1946.

enlarged increased density with a central small translucent area. This lesion was excised and reported to be osteoma, but in Weeden and Oliva's opinion the pathologist overlooked the osteoid material, and unfortunately neither the surgeons nor the pathologist saw the osteoid osteoma.

[ED. NOTE.—Osteoid osteoma is now a recognized clinical entity and deserves to be given a definite place in the "classification of neoplasms of bone and lesions simulating them." In the past many pathologists and orthopedic surgeons have classified osteoid osteoma as "sclerosing nonsuppurative osteomyelitis of Garré." An increasing number of cases have been reported, and as more and more physicians have become aware of the lesion, considerable statistical material should be available soon for further studies. The treatment is surgical, and the results of this are usually good when the nidus is completely excised.]

BENIGN GIANT CELL TUMOR

Mandl and Dwek [191] point out that more radical treatment of benign giant cell tumors and bone cysts is indicated in recent papers by outstanding authors who write on bone tumors; for example, Meyerding and Inclan recommend excision of the lesions, followed by bone grafting. Mandl and Dwek state that roentgen therapy is not too good even from a diagnostic standpoint and that primary therapeutic irradiation has no effect. The bone cyst and the giant cell tumor are closely related, and spontaneous healing of the cyst and union following fracture are not frequent in either lesion. Failure to heal and development of malignant changes seem to coincide, and the task of recognition of malignant degeneration should be placed in the hands of experts on pathologic processes in the bone. Mandl and Dwek describe 15 cases of benign giant cell tumors of bone, in 14 of which surgical treatment was given. The operations employed were excision and bone grafting, excision alone, resection and excochleation.

Brock and Bogart [192] reviewed the literature and collected reports of 91 cases of giant cell tumor of the spinal column. In 12 of these cases (13.1 per cent) the tumors were in the cervical vertebrae. In their article they present a case of destructive lesion of the fourth cervical vertebra in a man aged 20 years. A diagnosis of benign giant cell tumor was made at biopsy. The only treatment was roentgen

191. Mandl, F., and Dwek, J.: An Appeal for a More Radical Attitude in the Treatment of Bone Cysts and Giant Cell Tumors, J. Internat. Coll. Surgeons **9**:79-98 (Jan.-Feb.) 1946.

192. Brock, E. H., and Bogart, F. B.: Benign Giant Cell Tumor of the Spine: Report of a Case Occurring in the Cervical Spine, Am. J. Roentgenol. **54**:512-518 (Nov.) 1945.

irradiation, which resulted in recalcification of the lesion and in disappearance of all symptoms. During treatment, support was provided by a body cast and a special brace. Brock and Bogart state that roentgen therapy has long been recognized as a suitable means of treating benign giant cell tumor and that its use has grown in favor with surgeons and pathologists as well as with therapeutic radiologists during the past twenty years. They also discuss briefly the work of Kolodny, Brailsford, Rix and Geschickter and the arguments for and against primary biopsy or curettement or both. Brock and Bogart conclude that the mode of treatment will have to be determined at present in each case and that all phases of the individual case will have to be considered.

Proffitt and Wyatt [193] briefly review some of the history of giant cell tumors and report a case of giant cell tumor of bone in a male infant 4 months old. The tumor was located in the upper end of the left tibia. It was treated by curettage and chemical cautery. They say that previously the youngest patient with benign giant cell tumor who has been reported on was a child 2½ years old and the oldest was 61 years. In none of the cases reported has the tumor occurred in the humerus or the ribs.

Proffitt and Wyatt also state that these tumors were first recognized by Ambroise Paré and that he treated them by curettage or by repeated excision and effected cures.

Puente Duany [194] reports a case of giant cell tumor or, as he states, of "tumor of myeloplaxes" in a man 43 years old. An enormous tumor of bone had invaded the pelvic cavity and the surrounding soft tissues. It was proved at biopsy to be a tumor of the giant cell type. Because of the diffuse type of lesion, roentgen therapy alone was employed. The patient received several series of treatments, with considerable reduction in the size of the tumor, but large ulcerations subsequently developed over the tumor and his condition became and remained rather poor. The final outcome is not reported.

Cantril and Buschke [195] report 2 cases of benign giant cell tumor; one tumor was in the mandible and the other in the ulna. They were diagnosed on the basis of roentgenographic findings alone and were handled successfully by intensive roentgen therapy. Of particular interest is the remarkable result secured in the case of giant cell tumor

193. Proffitt, W. E., and Wyatt, O. S.: Giant-Cell Tumor of Bone in a Four-Month Old Infant, Journal-Lancet **66**:163-165 (May) 1946.

194. Puente Duany, N.: Tumor maligno de células gigantes de los huesos de la pelvis, regiones glútea y prostática, Arch. cubanos cancerol. **4**:264-274 (July-Sept.) 1945.

195. Cantril, S. T., and Buschke, F.: Roentgen Therapy of Benign Giant Cell Tumor of Bone, West. J. Surg. **54**:259-264 (June) 1946.

of the mandible. The authors state that roentgen therapy of giant cell tumors of bone is a highly satisfactory procedure and that it is the treatment of choice for this type.

Shallow and Wagner [196] present a case of pulsating giant cell tumor of the tibia in a man 20 years old. Curettement was employed first, later roentgen therapy and finally amputation of the limb. The tumor pulsated because it had access to soft tissue through an opening in the bone and also because large blood vessels entered it. Shallow and Wagner state that 6 cases have been reported previously and that many other tumors besides the giant cell type can pulsate, including malignant tumors of bone and metastatic lesions. In 3 of the 7 cases of pulsating giant cell tumors the limb was eventually sacrificed. The treatment advised is wide resection of bone or curettage and irradiation.

Shorvon [197] reports a case of giant cell tumor of the patella in a woman 37 years old. Apparently trauma was a precipitating factor. The treatment was total excision of the patella.

Haggart and Hare [198] present 7 cases of benign giant cell tumor of bone in which treatment was difficult because of the size and location of the tumor. Preoperative irradiation of all the tumors was carried out, followed by surgical curettage and removal of tumor tissue; the cavities were packed with bone chips. Operation was done eight to twelve weeks after irradiation. The extremity was saved in each case, and there was no recurrence. Haggart and Hare state that irradiation renders the tumor tissue less vascular, makes it easier to remove all the tissue and does not interfere with later healing of the wound.

Marottoli [199] presents a case of myeloplaxoma (giant cell tumor) of the ninth rib. Treatment consisted of excision of the tumor and wide resection of the rib at the same time. Roentgen therapy was used postoperatively. To date there has been a six year cure.

[Ed. Note.—As one of us (H. W. M.) has stated before, the medical profession continues to be much interested in giant cell tumors of bone. Treatment depends on the type and size of the lesion and

196. Shallow, T. A., and Wagner, F. B., Jr.: Pulsating Benign Giant Cell Tumors of Bone: Report of a Case and Review of the Literature, Arch. Surg. **52**:661-676 (June) 1946.

197. Shorvon, L. M.: Giant-Cell Tumours (Osteoclastomata) with Report of a Case in the Patella, Brit. J. Radiol. **19**:474-476 (Nov.) 1946.

198. Haggart, G. E., and Hare, H. F.: Combined Roentgen Radiation and Surgical Treatment of Large Benign Giant Cell Tumors of Bone, Ann. Surg. **124**: 228-244 (Aug.) 1946.

199. Marottoli, O. R.: Tumor a mieloplaxas de costilla, Bol. Soc. de cir. de Rosario **13**:237-242 (Sept.) 1946.

on the correct diagnosis. There is considerable difference of opinion concerning the value of microscopic and roentgenologic diagnosis. As stated in the last report, it is best to have the roentgenologic diagnosis confirmed by an expert pathologist, as the so-called clinical and roentgenologic features sometimes prove untrustworthy. If it is assumed that the roentgenologic diagnosis of giant cell tumor is correct and that the lesion may be cured by roentgen therapy, the question arises of whether it is best to treat all tumors by roentgen therapy or whether excision and bone graft are wise in certain cases in which the situation of the lesion is such that they may be performed with a minimal loss of time and money to the patient.

Furthermore, the giant cell lesions of bone have been classed by one of us (H. W. M.) as benign giant cell tumor and malignant giant cell sarcoma. If these two terms are borne in mind, there will be less confusion concerning diagnosis, prognosis and proper treatment of a giant cell lesion. It does not seem possible to distinguish the benign giant cell lesion from the malignant giant cell sarcoma by roentgenologic examination alone.]

OSTEOCHONDROMA

Ghormley, Meyerding, Mussey and Luckey [200] give an analysis of 40 cases of osteochondroma of the pelvis. The diagnosis of osteochondroma was verified at operation in their cases, and results of roentgenologic examination and histologic studies and the survival rate are reported. Sixty-nine operations were performed on 40 patients. The difficulty of making an accurate clinical diagnosis and also the difficulty of complete removal of the lesion and the necessity for it are stressed. Malignant change has been recorded, and frequent recurrences take place unless all cells of the tumor, histologically benign or malignant, are eradicated. Because of the nature of these lesions, formidable operations are sometimes indicated, and it is in this group that the interinnominoabdominal amputation finds its most favorable indication.

Thomas [201] reports a case of chondrosarcoma of the first metatarsal bone and states that from a review of the literature sarcoma of the metatarsal bone seems to be a comparatively rare condition. The incidence of five year cures in the cases reviewed was roughly 33 per cent. The author reiterates the views of Lichenstein and Jaffee in regard to cartilaginous tumors, namely, that these tumors should not

200. Ghormley, R. K.; Meyerding, H. W.; Mussey, R. D., and Luckey, C. A.: Osteochondromata of the Pelvic Bones, J. Bone & Joint Surg. **28**:40-48 (Jan.) 1946.

201. Thomas, I. J.: Sarcoma of the Metatarsal Bone: A Brief Review of the Literature with One Personal Case, Brit. J. Surg. **33**:191-194 (Oct.) 1945.

be regarded as benign if viable and not heavily calcified areas show, even in scattered microscopic fields, (1) many cells with plump nuclei, (2) more than an occasional cell with two nuclei or (3) any giant cartilage cells with large single or multiple nuclei or with clumps of chromatin. If these criteria are observed, it is believed that the prevalent tendency to mistake chondrosarcoma in an early stage of malignancy for a benign lesion can be overcome.

Hill and Todd [202] report a successful hindquarter amputation for a chondromyxosarcoma of the right thigh.

Rocher [203] reports a case of a large chondroma of the lower end of the femur in which amputation rather than local excision had to be done because of the extensive involvement of the thigh. Interestingly, the patient, a man 47 years old, had apparently had the lesion for only seven months before treatment.

Gurney and Cohen [204] report multiple chondromas involving the hands, feet, some of the long bones, scapulae and pelvis in a man 21 years old.

Barata [205] reports a case of tumor of the mandible in a man 25 years old. The tumor, which was about the size of an orange, was situated on the internal aspect of the body of the mandible. It was excised and diagnosed as a chondroma by one pathologist; the whole tumor was then sent to another pathologist, who diagnosed it as a chondromyxosarcoma. The results of the examination were different on different occasions. This occurrence led the author to the conclusion that the histologic structure of any of these tumors cannot be determined with accuracy from one biopsy and also that histopathologic and clinical observation should be made before any therapeutic measures are attempted. The patient was again seen eight months after excision of the tumor. It had recurred, and further attempts at treatment were unsuccessful.

Stiller [206] reports a case of osteofibrochondroma of the scapula in a white child 2 months old. The diagnosis was confirmed at biopsy. The tumor was larger than the whole of the normal scapula. No treatment is recorded.

---

202. Hill, I. M., and Todd, I. P.: A Case of Hindquarter Amputation for Chondromyxosarcoma of the Right Thigh, Brit. J. Surg. **33**:277-279 (Jan.) 1946.

203. Rocher, H. L.: Volumineux enchodrome du fémur ayant nécessité l'amputation de cuisse à la partie moyenne, Mém. Acad. de chir. **72**:16-17 (Jan. 16-30) 1946.

204. Gurney, R., and Cohen, L.: An Unusual Case of Multiple Chondromata, Radiology **46**:48-52 (Jan.) 1946.

205. Barata, E.: Tumor osteogênico da mandíbula, Brasil-med. **59**:244-247 (July 7-14) 1945.

206. Stiller, R.: Osteofibro-Chondroma of Scapula in New Born Infant: Case Report, Clin. Proc. Child. Hosp. **2**:241-243 (Sept.-Oct.) 1946.

From the Massachusetts General Hospital [207] a case involving a woman 56 years of age is reported. Chondroma of the eighth rib had been present for about two years. It measured 4 by 6 cm. The treatment was radical excision of segments of the seventh and ninth ribs and a full excision of the eighth rib. The desirability of radical excision of chondromas of the chest because of the spread of the tumor cells through marrow cavities is stressed.

[ED. NOTE.—It is obvious from the foregoing reports that the diagnosis of this group of tumors, chondromas and osteochondromas, requires a most careful analysis of the clinical, roentgenologic and histopathologic findings. Early diagnosis followed by complete excision of the tumor offers the patient the best prognosis. Unfortunately, they do not, as a rule, cause much pain and disability, and in the past patients have come to the surgeon for treatment only after pronounced growth and often involvement of other vital structures have occurred. We do not have faith in needle biopsy for this type of lesion because the same mass may contain benign tumor tissue and malignant tumor tissue. In our experience, roentgen therapy has not proved to be of any great assistance in the treatment of patients with this lesion. The tumor involving the pelvic bones which attain considerable size and which cannot be entirely eradicated or which shows evidence of a malignant process offers the largest field for interinnominoabdominal amputation.]

VASCULAR TUMORS OF BONE

Hemangioma.—Kaplan [208] discusses briefly hemangioma of bone and presents a case of hemangioma of the spinal column with signs of compression of the cord. The patient was a boy 12½ years old. Diagnosis was verified by biopsy, and a cure was effected by roentgen therapy.

King's [209] case involved a boy, 11 years old, who had a bony lesion of the lower end of the femur. The lesion consisted essentially of a widespread sprouting of capillaries. Amputation was done through the middle of the thigh, and later there was evidence of the lesion proximally; the recurrence was controlled with roentgen treatment.

Hemangioendothelioma (Ewing's Tumor, Ewing's Sarcoma, Multiple Endothelioma, Solitary Diffuse Endothelioma, Angioendothelioma, Endothelial Myeloma, Angiosarcoma).—Jaffe [210] presents his findings

207. Chondroma of Eighth Costal Cartilage, Cabot Case 32442, New England J. Med. **235**:663-665 (Oct. 31) 1946.

208. Kaplan, I. I.: Vertebral Hemangioma in Children, J. Pediat. **28**:498-502 (April) 1946.

209. King, D. J.: A Case Resembling Hemangiomatosis of the Lower Extremity, J. Bone & Joint Surg. **28**:623-628 (July) 1946.

210. Jaffe, H. L.: Pathology: Problem of Ewing Sarcoma of Bone, Bull. Hosp. Joint Dis. **6**:82-85 (Oct.) 1945.

from a study of 17 cases of Ewing's sarcoma. He compares these findings with the original description of Ewing's tumor. This histogenesis is also discussed, and the author's views are compared with those of others. He points out the difficulty encountered in making the diagnosis clinically and histologically and mentions the "doleful prognosis." Only 1 of his 17 patients was alive at the time of writing, and this patient had been under observation for only five months.

A case of Ewing's tumor of the first left rib with extension into the lung and neck is presented from the Massachusetts General Hospistal.[211] The tumor was removed surgically and the patient treated with roentgen therapy.

Imler, Meilstrup and Bogart[212] reviewed the pertinent literature on Ewing's sarcoma of the spinal column and found 10 cases. They add 1 case of their own, which involved a white man aged 21 years. The initial site of the lesion was in the right half of the twelfth thoracic vertebra. There was no evidence of spread to the lungs or to other bone. The response to irradiation therapy was typical of Ewing's bone sarcoma, but it was not anticipated that the treatment would provide any more than temporary palliation. The diagnosis was established by biopsy.

Another report from the Massachusetts General Hospital[213] describes a case of Ewing's tumor of the right clavicle in a woman 20 years old. Roentgen treatment was given, and two months later the clavicle was excised; no tumor cells could be detected. Mallory makes the statement that in a fair number of the cases in which roentgen treatment is employed local recurrence does not appear even in the face of metastasis.

Zuckermann,[214] in a chapter on Ewing's neoplasm of bone, writes that about 15 per cent of the primary malignant tumors of bone are of this type. It is more frequently found in the male than in the female and is usually encountered in the earlier age groups. The prognosis is extremely poor.

[ED. NOTE.—Hemangiomas of the vertebrae are relatively common, and characteristic roentgenologic findings are vertebral striations involving practically the entire body of the vertebra, although extension into the lamina and other parts may be present. These hemangiomas of the vertebrae may collapse, and compression myelitis may or

211. Ewing's Sarcoma of First Rib, Cabot Case 32091, New England J. Med **234**:304-307 (Feb. 28) 1946.

212. Imler, A. E.; Meilstrup, D. B., and Bogart, F. B.: Primary Ewing's Sarcoma of the Spine, Radiology **46**:597-600 (June) 1946.

213. Ewing Tumor of Clavicle, Cabot Case 32432, New England J. Med. **235**: 630-632 (Oct. 24) 1946.

214. Zuckermann, C.: Neoplasias óseas de Ewing, Rev. mex. de cir., ginec. y cáncer **13**:291-294 (Oct.) 1945.

may not follow. The lesion often is found incidentally in routine roentgenologic examination of the spinal column and may be symptomless. Töpfer [215] found 257 hemangiomas in vertebrae sectioned in the course of 2,154 routine necropsies. We believe that roentgen therapy and protection by means of a brace or cast is the treatment of choice when the patient has pain.

One of us (H. W. M.) has recently presented the following classification of vascular neoplasms of bone:

I. Benign angioma
  A. Hemangioma
    (1) Cavernous
    (2) Capillary
    (3) Plexiform
    (4) Fibrous (secondary fibrosis)
  B. Lymphangioma (extremely rare)

II. Malignant angioma; endothelioma
  A. Hemangioendothelioma (Ewing's tumor, Ewing's sarcoma, multiple endothelioma, solitary diffuse endothelioma, angioendothelioma, endothelial myeloma, angiosarcoma)
  B. Lymphangioendothelioma (extremely rare)

There is no universally accepted classification of tumors of bone, and the problem confronting the surgeon and the roentgenologist is the differentiation between the benign and malignant forms. Some physicians do not include hemangioendothelioma (Ewing's tumor) with the vascular tumors. Ewing, himself, however, classified the tumor as an endothelioma originating from the endothelium of the blood vessels of the cortex of bone and described three subdivisions: (1) multiple endothelioma; (2) angioendothelioma and (3) solitary diffuse endothelioma. The entire subject of vascular tumors of bone as discussed and presented before the American Academy of Orthopaedic Surgeons in January, 1948, will be published in the transactions of this society by Edwards Brothers, Inc., Ann Arbor, Mich.]

OSTEOGENIC SARCOMA

MacDonald and Budd,[216] opposing the views of such writers as Sutherland and McNattin, say that bone tumors show no fixity of

215. Töpfer, D.: I. Ueber ein infiltrierend wachsendes Hämangiom der Haut und multiple Kapillarektasien der Haut und inneren Organe; II. Zur Kenntnis der Wirbelangiome, Frankfurt. Ztschr. f. Path. **36**:335-345, 1928.

216. MacDonald, I., and Budd, J. W.: Osteogenic Sarcoma: II. Roentgenographic Interpretation of Growth Patterns in Bone Sarcoma, Surg., Gynec. & Obst. **82**:81-86 (Jan.) 1946.

pattern and hold a thesis that the roentgenologic study of bone tumors is an interpretation of the activity of the neoplasm and also of the character of the stromal response. Thus, the appearance of a bone tumor at a given time depends on the balance between neoplastic activity and the degree of cortical and medullary reaction as well as on the absence or extent of ossification and calcification. They point out that the "sun ray" appearance may be seen in any tumor and that Codman's time-honored "reactive triangle" may be seen in chronic periostitis. They reviewed 118 cases in which bone sarcoma was listed as cured in the Registry of Bone Sarcoma of the American College of Surgeons and in a prior article established some features relating to the natural history and the histopathologic changes in these cases which they thought sufficiently distinctive to account for the curability. They divide the connective tissue sarcomas of bone into chondrosarcomas, osteosarcomas and fibrosarcomas and do not use the term "osteogenic sarcoma" except in a generic sense. [ED. NOTE.—All types of the aforementioned cellular structure or a combination of two or more may be the predominating or only tissue in the so-called osteogenic sarcoma, that is, osteochondrofibrosarcoma. Much variation in the types of cellular structure is seen. It is impossible to tell what the basic cell in a highly anaplastic tumor should be.] MacDonald and Budd say that the roentgenologist may make the diagnosis of osteogenic sarcoma but that this study forces them to conclude that the roentgenographic criteria are highly unreliable for a more accurate differential diagnosis. They believe that there is a prognostic importance in the differentiation into the different types of cellular structure. For instance, 12 per cent of the patients cured in their series and 40 per cent of those who died had osteosarcoma; 37 per cent of those cured and 15 per cent of those who died had fibrosarcoma, and the figures on those who had chondrosarcoma were in a median position.

In conclusion MacDonald and Budd state that the roentgenologist can determine whether the lesion is benign or malignant with a high degree of accuracy but beyond that the differential diagnosis is to be regarded as speculative. They hold that open biopsy remains the most essential single diagnostic method for all types of bone tumor with the exception of Ewing's sarcoma, and they state that there is no reliable evidence to show that biopsy is a hazardous procedure. They finally state that to employ intensive irradiation for bone lesions on roentgenographic evidence alone is an unwarranted intellectual obeisance to a fallible diagnostic measure.

[ED. NOTE.—Open biopsy, with removal of sufficient tissue to give the pathologist ample material for histopathologic studies, is essential for accurate prognosis in cases of osteogenic sarcoma. We have laid

emphasis on the value of the gradation of the degree of malignant change in the cell. We do not believe that biopsy is a hazardous procedure, nor, in our experience, has it led to any untoward metastasis.]

Brailsford [217] discusses the wide variation in the clinical symptoms of a patient suffering from a malignant tumor of bone. Biopsy is again urged, although the author cautions that the differentiation of some normal processes, for example, callus, may be difficult. He lists again the many roentgenographic signs of a malignant process. Treatment when definite diagnosis is made is resection of the bone containing the tumor or, when resection is not advisable, amputation. He makes the statement that radiation on the whole has afforded little benefit.

Gordon-Taylor and Patey [218] add another 10 cases, in which interinnominoabdominal operation was carried out, to the 11 which one of them (Gordon-Taylor) had previously reported. Taylor also summarized the data in 73 cases recorded in the literature, or in those known to the authors since 1935. Gordon-Taylor states that recovery after operation occurs in 82 per cent of cases, which is a great improvement over the 40 per cent previously recorded, but that an exceedingly small number of the patients are still alive a reasonable length of time after the operation. They state that the prognosis is best in cases of chondroma or chondrosarcoma, although a few patients who have had other types of sarcomas have survived as long as five to seventeen years.

Woltman, Adson and Abbott [219] report an unusual and interesting case. The patient, a woman 37 years old, had injured the left shoulder, and pain, weakness and some atrophy of the left upper extremity had occurred subsequently. Improvement was noted three years later after physical therapy and other conservative measures had been carried out. Nine years after the original trauma she again presented herself for treatment, with the complaint of pain and of inability to use the left upper extremity. Roentgenograms showed neuritis ossificans; on surgical excision the lesion proved to be osteogenic sarcoma, grade 1.

Rosh and Raider [220] report on 121 cases of primary bone tumors. They state that they found 45 cases of osteogenic sarcoma and that

217. Brailsford, J. F.: Malignant Tumors of Bone, J. Internat. Coll. Surgeons **9**:62-78 (Jan.-Feb.) 1946.

218. Gordon-Taylor, G., and Patey, D. H.: Further Review of Interinnomino-Abdominal Operation Based on Twenty-One Personal Cases, Brit. J. Surg. **34**: 61-69 (July) 1946.

219. Woltman, H. W.; Adson, A. W., and Abbott, K. H.: Neuritis Ossificans with Osteogenic Sarcoma in Brachial Plexus Following Trauma: Report of Case, Journal-Lancet **66**:372-376 (Nov.) 1946.

220. Rosh, R., and Raider, L.: Primary Malignant Bone Tumors: A Review of Cases Seen in the Radiation Therapy Department of Bellevue Hospital, Am. J. Roentgenol. **56**:75-84 (July) 1946.

early amputation gives the best chance for survival in these cases. (This chance, however, is only about 25 per cent.) There were 8 more of chondrosarcoma. Among the patients who had primary chondrosarcoma only a few survived for much more than one year after operation. Of those who had secondary chondrosarcoma, 3 survived for more than five years. The report records 32 cases of Ewing's tumor, with cure in about 10 per cent as a result of roentgen therapy or amputation or both. There were 18 cases of multiple myeloma. Rosh and Raider state that patients who have multiple myeloma seldom survive for any length of time. They report on 18 cases of giant cell sarcoma and make the statement that excision and irradiation constitute the best treatment.

[ED. NOTE.—The terminology employed for giant cell tumors is somewhat misleading unless the benign giant cell tumor is clearly defined as the benign lesion and is distinguished from the malignant giant cell sarcoma. In a previous report one of us (H. W. M.) has classified the giant cell tumors as follows:

I. Giant cell tumors
   A. Benign giant cell tumor
   B. Malignant giant cell sarcoma
      1. Primary malignant giant cell sarcoma
      2. Secondary malignant giant cell sarcoma.]

Coley [221] stresses the importance of the history, the physical examination and the roentgenologic and laboratory studies in the differential diagnosis of neoplasms of bone. He states that histologic examination is the most important single measure at the physician's command in arriving at a correct diagnosis.

Hilton and Glynn [222] report the case of a man, 26 years old, who on roentgenographic examination had a sclerosing osteogenic sarcoma in the upper part of the right femur. Extensive roentgen therapy was administered, with relief of symptoms and gradual increase of calcification throughout the tumor. Much later the patient fractured the femur during an air raid, and amputation was done. Examination of the specimen at the time of amputation showed no evidence of sarcoma. Thus a twelve year cure occurred in a case of sclerosing osteogenic sarcoma in which the diagnosis was made radiologically.

---

221. Coley, B. L.: The Diagnosis of Neoplasms of Bone, S. Clin. North America **26**:410-421 (April) 1946.

222. Hilton, G., and Glynn, L. E.: A Case of Sarcoma of Bone Treated by Radiotherapy, Brit. J. Radiol. **19**:198-202 (May) 1946.

MULTIPLE MYELOMA

Bayrd and Heck [223] present an excellent discussion of the clinical findings in cases of multiple myeloma and describe 2 cases in which the condition simulated senile osteoporosis. The high sedimentation rate indicated a need for further studies, and these revealed an extremely high concentration of serum protein and roentgenographic changes. Sternal punctures yielded evidence on which the diagnosis of multiple myeloma was made. Bayrd and Heck state that the disease may be suspected if there is musculoskeletal pain, renal disease as shown by the presence of albuminuria, a high level of serum protein, with inversion of the albumin-globulin ratio, a high sedimentation rate and local areas of rarefaction or osteoporosis. Also diagnostically, there is rouleaux formation of red blood cells in the smear, and myeloma cells may be found in bone marrow and, in about 10 per cent of cases, in peripheral blood. The 2 cases reported are interesting in that the only changes in the bones evident roentgenographically were those of generalized osteoporosis.

[ED. NOTE.—To those interested in this subject we recommend the report of Bayrd and Heck.]

Gill [224] reports a case of multiple myeloma in a woman, 38 years old, who had notable hypercalcemia, progressive weakness, anemia, apparent bone cysts and pathologic fractures. A diagnosis of hyperparathyroidism was made. At operation normal parathyroid glands were found. Later biopsy of bone marrow showed typical multiple myeloma cells, and this diagnosis was confirmed at necropsy three months after operation and about ten months after the onset of symptoms.

[ED. NOTE.—There are several other cases in which exploratory operations have been done because of similar roentgenographic findings and parathyroid tumors have not been found.]

Snapper [225] discusses the treatment of multiple myeloma with 4,4′-diamidinostilbene ("stilbamidine") and presents the results. He states that the chief results are diminution of pain and also some improvement in the local conditions. There also may be some morphologic changes in the myeloma cells themselves.

---

223. Bayrd, E. D., and Heck, F. J.: Multiple Myeloma: Report of Two Cases, Proc. Staff Meet., Mayo Clin. **21**:49-53 (Feb. 6) 1946.

224. Gill, D.: Multiple Myeloma Simulating Hyperparathyroidism, Ann. Int. Med. **24**:1087-1093 (June) 1946.

225. Snapper, I.: On the Influence of Stilbamidine upon Multiple Myeloma, J. Mt. Sinai Hosp. **13**:119-127 (Sept.-Oct.) 1946.

Marchal, Mallet, Lotte and Davy [226] report a case involving a woman 61 years old in which the roentgenologic findings were indicative of multiple myeloma and studies of blood and marrow revealed considerable anemia and an unusual predominance of plasmocytes. Five months after the onset of symptoms the patient died of bronchopneumonia. Necropsy revealed diffuse involvement of the marrow with plasmocytes, some of which showed atypical mitosis. The number of plasmocytes in the blood increased rapidly up to the time of the patient's death.

Marchal and Mallet [227] also report 2 cases of plasmocytoma. In 1 case the tonsils were the site of the plasmocytoma and in the other the maxillary and ethmoid sinuses. Local irradiation resulted in apparent cure for more than four years in both cases. Subsequently, slow invasion of the skeletal system occurred, and the evidence of multiple myeloma appeared in the roentgenograms. Bence Jones protein was not present. In both cases hyperproteinemia, with increase of albumin in relation to globulin, was present in the early stages of the involvement of bone, and biopsy revealed replacement of bone by tissue composed of plasmocytes with a few pathologic mitotic figures and other nuclear irregularities.

Stout [228] presents a case of plasma cell myeloma involving the upper ends of both tibias. Biopsy of material from one lesion was carried out. Bence Jones protein was found in the urine on only one occasion.

Jansson [229] points out that multiple myeloma is extremely rare in children and that in a complete review of the literature of the world Schaffa, in 1939, found only 8 cases of myelomatosis among children. Jansson reports a case involving a boy aged 9 years. Roentgenographic examination did not show evidence of any lesion in the skull or the ribs, but there were typical punched-out lesions in the pelvis, both femurs, both knees and both shoulders. In addition, there was generalized platyspondylia; all segments were reduced to thin plates with biconcave configurations. The diagnosis of multiple myeloma was proved at necropsy.

---

226. Marchal, G.; Mallet, L.; Lotte, A., and Davy, M.: Myélome multiple des os terminé par une leucémie plasmocytomyélocytaire aiguë, Sang **16**:564-571, 1944-1945.

227. Marchal, G., and Mallet, L.: Diffusion par étapes successives de myélomes localisés, Sang **16**:555-564, 1944-1945.

228. Stout, A. P.: Plasma Cell Myeloma (Bilateral) of Tibia, Texas State J. Med. **41**:593-594 (March) 1946.

229. Jansson, G.: Roentgenologic Skeletal Changes in Myeloma in Childhood (Platyspondylia Generalisata Myelomatosa), Acta radiol. **27**:73-80, 1946.

METASTATIC LESIONS OF BONE

Gormsen [230] gives a review of the method of obtaining tumor cells from sternal punctates (sternal aspirations) in cases of primary or metastatic lesions of bone. He presents a series of about 263 cases in which a total of 311 punctures had been made in the search for malignant cells. About 18 per cent of the punctates contained tumor cells. Most punctates in cases of multiple myeloma yielded tumor cells. Tumor cells were demonstrated in a small percentage of the punctates in case of metastatic lesions. Gormsen states that sternal puncture is of definite value in the differentiation of multiple myeloma from widespread metastatic lesions and that sternal puncture in cases of metastatic carcinoma may sometimes give a clue as to the nature of the patient's illness.

Mallet [231] also discusses puncture and aspiration of bone marrow in regions in which metastatic carcinoma is suspected. He states that they may be of similar value in the presence of pathologic fractures and indeterminate pain in areas of bone when the diagnosis is uncertain. Carcinoma of the breast and other epithelial tumors usually contain cells which are readily diagnosed as malignant when there is involvement of the marrow but do not always retain their normal histologic appearance. He is of the opinion that extensive metastatic invasion of bone from carcinoma of the thyroid and the prostate is rare. Mallet further states that carcinoma cells can often be found in cases of carcinoma of the prostate by aspiration in the region of the greater trochanter of the femur. In the presence of other metastatic lesions of bone medullary reaction is the only basis for a diagnosis of medullary invasion, and the medullary reaction is evidenced by increases in the lymphoblastic, myoblastic and erythroblastic elements in the bone marrow.

[ED. NOTE.—In view of the present interest in the cytologic diagnosis of carcinoma, this article is interesting. Stomach washings frequently contain malignant cells, and studies of sputum may disclose the presence of bronchiogenic carcinoma.]

Khanolkar and Nerurkar [232] report on the technic of needle biopsy. They present 30 cases in which aspiration biopsy was carried out; they were unable to obtain tissue in only 4. They state that less trouble with wound healing occurs and there is not as much danger

230. Gormsen, H.: Om paavisning af tumorceller i sternalpunktater, Nord. med. **14**:1320-1324 (May 2) 1942.

231. Mallet, L.: Les modifications médullaires et sanguines au cours des métastases cancéreuses: Leur intérêt au point de vue radiologique, J. de radiol. et d'électrol. **26**:245-252, 1944-1945.

232. Khanolkar, V. R., and Nerurkar, R. V.: Diagnosis of Bone Tumors by Aspiration: Review of Thirty Cases, Indian Physician **5**:125-135 (June) 1946.

of spreading the tumor with this form of obtaining a specimen for biopsy as with the usual exploratory incision.

Samson [233] discusses the early diagnosis of cancer of the bone, the importance of age and of obtaining a history of trauma, the site of the lesion and its appearance in the roentgenograms. He further discusses the course of the disease and the differential diagnosis, mentioning ossified hematomas, osteomyelitis, syphilitic osteitis, bone cysts, exostoses, osteomas, enchondromas, Paget's disease and giant cell tumors.

Weingart [234] reports a case of carcinoma of the lung with intracranial and skeletal metastasis. In this case the lesion had been present for about eight years, and there apparently were intervals during which the patient was mentally upset. Interestingly enough, the left third toe was involved by metastatic lesion, and also other lesions were found in the occiput and the ribs.

Thomas [235] reports on 168 cases of metastatic carcinoma of the bony skeleton. In 11 (6 per cent) of these cases the carcinoma originated in the gastrointestinal tract. He states that ordinarily the treatment of metastatic lesions in the skeleton is strictly palliative. Occasionally active treatment is indicated, as in the case he reports in which a pathologic fracture of the hip was secured with internal fixation.

Tötterman [236] reports a case of gelatinous carcinoma of the stomach with metastasis to the bone marrow. The patient died in somewhat more than a month after becoming ill, at which time the picture was that of severe normochromic, hemolytic anemia.

Dustin,[237] writing on the morphologic changes in the blood provoked by metastatic involvement of the bone marrow, reports a study of 11 cases and states that the blood picture, the extent of invasion of the medulla by the metastatic lesion and the occurrence of extramedullary erythropoiesis and granulopoiesis were not related. The medullary metastatic lesions interfere particularly with the maturation of the red blood cells, whose fragility may be increased. This dyshematopoiesis is an effect of the toxic secretions of the tumor cells, and it is most frequently encountered in cases of gastric carcinoma.

---

233. Samson, J. E.: Le diagnostic précoce du cancer des os, Union méd. du Canada **75**:1009-1023 (Sept.) 1946.

234. Weingart, J. S.: Carcinoma of the Lung with Intracranial and Skeletal Metastases, J. Iowa M. Soc. **36**:447-450 (Oct.) 1946.

235. Thomas, G. L.: Metastasis to Bone in Gastrointestinal Malignancy, S. Clin. North America **26**:692-694 (June) 1946.

236. Tötterman, L. E.: Hemolytisk anemi av Lederer-typ vid ventrikelkarcinom med benmärgsmetastaser, Nord. med. **30**:1006-1012 (May 3) 1946.

237. Dustin, P., Jr.: Les réactions sanguines provoquées par l'envahissement métastatique de la moëlle osseuse, Acta med. Scandinav. **125**:220-235, 1946.

Van der Sar and Hartz [238] report a case of skeletal lymphosarcomatosis in which all the findings were indicative of secondary hyperparathyroidism. The patient was a man 55 years old.

Windholz [239] reports a case involving a woman, 60 years old, who was admitted to the hospital for studies of hypertension. Roentgenologic examination showed numerous rounded sclerotic densities of various sizes in the bony skeleton. Biopsy revealed a neoplastic lesion of the bone, but a diagnosis of myeloma could not be made. Windholz states that the tissue was obviously reticuloendothelial in nature, but studies after injection of thorium dioxide showed no evidence of involvement of the liver or spleen. Postmortem examination was not allowed. The literature reviewed failed to disclose any other report of a multiple primary bone-forming reticuloendothelial tumor.

Rousseau and Giroux [240] report a case of extensive pulmonary metastasis from synovial sarcoma of the right arm. The sarcoma apparently developed at the site of an injury a few months after the injury occurred. The tumor was excised about four and a half years later, and the patient died six years after the original injury and one year after symptoms of pulmonary metastasis developed.

Adair and Herrmann [241] report 11 cases of lesions which had metastasized to the mandible. Five cases are reported in which there were unusual metastatic manifestations of carcinoma of the breast. They advance a theory that the mandible is infrequently involved by metastatic disease because of the customary absence of red bone marrow.

Byars and Sarnat [242] review a series of 12 cases in which multilocular radiolucent areas were seen in roentgenograms of the mandible. These lesions have been demonstrated in cases of ameloblastoma, multiple follicular cysts, giant cell tumor, fibroma, fibrosarcoma, osteogenic sarcoma and metastatic carcinoma, particularly of the breast and thyroid. The authors stress the fact that the diagnosis of ameloblastoma or any other tumor should not be made from the roentgenogram alone.

---

238. van der Sar, A., and Hartz, P. H.: Skeletal Lymphosarcomatosis with Secondary Hyperparathyroidism, Am. J. Clin. Path. **16**:701-713 (Nov.) 1946.

239. Windholz, F.: Disseminated Reticuloendothelial Tumor of the Bone Marrow with Nodular Osteosclerosis, Arch. Path. **42**:206-213 (Aug.) 1946.

240. Rousseau, L., and Giroux, M.: Synovialosarcome du bras droit: Métastases pulmonaires étendues, Laval méd. **11**:614-621 (June) 1946.

241. Adair, F. E., and Herrmann, J. B.: Unusual Metastatic Manifestations of Breast Carcinoma: I. Metastasis to the Mandible with a Report of Five Cases, Surg., Gynec. & Obst. **83**:289-295 (Sept.) 1946.

242. Byars, L. T., and Sarnat, B. G.: Mandibular Tumors: A Clinical, Roentgenographic, and Histopathologic Study, Surg., Gynec. & Obst. **83**:355-363 (Sept.) 1946.

In Bersack and Feinstein's [243] case widespread myelofibrosis was secondary to carcinoma of the prostate in a man 35 years old. They state that theirs is the third case of this type to be found in the English literature. Clinically, destruction of bone marrow and an attempt at compensation by the remaining hemopoietic tissue were recognized.

Laborde and Kritter [244] write on the metastatic and neoplastic propagations into the skeletal system in cancer of the uterine neck and report involvement of the bone in 14 of 1,743 cases of cancer of the cervix (0.8 per cent). In 11 of these there were metastatic lesions and in 3 extensions to the bony pelvis. They report local destruction of bone, with complete loss of architecture and replacement by neoplastic tissue and also partial decalcification of the surrounding bone. They are of the opinion that roentgen therapy is the only method of treating these metastatic lesions.

Aschner and Mayer [245] present a case of carcinoma of the prostate in a man 50 years of age. The patient was given 1 mg. of diethylstilbestrol three times daily; within one week he felt better, and within three weeks the pain had completely disappeared and roentgenograms of the pelvis showed a diminution in the size of the lesion in the right femoral neck. Three years later the roentgenographic appearance of the bone was normal; the prostate gland gave no evidence of the original lesion through the rectum, and the patient was well clinically.

EOSINOPHILIC GRANULOMA

Dundon, Williams and Laipply [246] present data on 5 cases of eosinophilic granuloma of bone. They also give an excellent review of the history, etiology, incidence, pathologic changes, prognosis, treatment and findings. A complete bibliography is appended. They state that the cause is unknown as yet but that at present most authors consider the lesion to be of inflammatory nature. The mononuclear histocyte or foam cell is considered to be the characteristic cell, and this raises a question of possible relationship to Letterer-Siwe and Hand-Schüller-Christian disease.

---

243. Bersack, S. R., and Feinstein, H. R.: Secondary Myelofibrosis with Progressive Generalized Osseous Eburnation, Am. J. Roentgenol. **56**:470-479 (Oct.) 1946.

244. Laborde, S., and Kritter, H.: Les métastases et les propagations néoplasiques au niveau du système osseux dans le cancer du col utérin, J. de radiol. et d'électrol. **26**:1-3, 1944-1945.

245. Aschner, P., and Mayer, L.: Metastatic Neoplasm of Pelvic Bones Treated by Stilbestrol, Bull. Hosp. Joint Dis. **6**:110-113 (Oct.) 1945.

246. Dundon, C. C.; Williams, H. A., and Laipply, T. C.: Eosinophilic Granuloma of Bone, Radiology **47**:433-444 (Nov.) 1946.

Skorpil [247] studied 7 cases of eosinophilic granuloma, in 3 of which skin and mucous membranes only were affected; in the other 4 the bones were affected. He presents 1 case in detail. He concludes that the granulomas are histocytic and eosinophilic in nature and that the disease is related to the morbid condition called "Hand-Schüller-Christian disease." The opinion that the lesions are of neoplastic nature is rejected by him, especially in view of the histologic analysis; the etiology and the pathogenesis remain obscure.

Hamilton, Barner, Kennedy and McCort [248] report the roentgen findings in 9 cases, in all of which the diagnosis was proved by biopsy at an army general hospital. They report that these lesions occur usually in young men although this is not necessarily a consistent finding. There are no characteristic locations for the lesions, and they may be solitary or multiple.

Wellensiek [249] reports a case of swelling of the scalp in the parietal region and inflamed tender gingivae in a boy 4 years old. Roentgen examination showed a destructive lesion of the skull. Eosinophilia was present. An initial diagnosis of malignant tumor was made after biopsy of material from the lesion in the scalp. The mandibular biopsy was done, and a diagnosis of eosinophilic granuloma was made. The lesions responded well to irradiation.

Cox [250] reports 3 cases of eosinophilic granuloma of bone in young adults; oral lesions gave rise to the primary symptoms. The importance of biopsy in diagnosis is emphasized again because involvement of multiple bones may be missed unless the nature of the lesion is recognized.

Riley [251] reports a case of eosinophilic granuloma of the second rib on the right in a man 25 years old. The preoperative roentgenologic diagnosis was eosinophilic granuloma, and this was confirmed by examination of the surgical specimen. Riley says that a localized destructive lesion with little or no surrounding reactive condensation, no soft tissue mass and no signs or symptoms other than local pain in a relatively young person should suggest eosinophilic granuloma.

---

247. Skorpil, F.: Zur Geschichte, Klinik und pathologischen Anatomie des eosinophilen Granuloms, Schweiz. Ztschr. f. Path. u. Bakt. **9**:233-255, 1946.

248. Hamilton, J. B.; Barner, J. L.; Kennedy, P. C., and McCort, J. J.: The Osseous Manifestations of Eosinophilic Granuloma: Report of Nine Cases, Radiology **47**:445-456 (Nov.) 1946.

249. Wellensiek, E. K.: Eosinophilic Granuloma, J. Dent. Research **25**:261-265 (Aug.) 1946.

250. Cox, M. E.: Eosinophilic Granuloma of Bone with Primary Oral Manifestations: Report of Three Cases, Am. J. Orthodontics **32**:569-578 (Sept.) 1946.

251. Riley, P.: Eosinophilic Granuloma of Bone: Report of a Case with Preoperative Roentgen Diagnosis, Radiology **47**:514-516 (Nov.) 1946.

Bakody [252] reports a case involving a youth, 17 years old, who had a tender swelling of the left side of the forehead of five weeks' duration. This lesion was excised, and the resulting fronto-orbital defect was covered with a tantalum plate. No other treatment was given postoperatively, and the patient made an uneventful and complete convalescence. Bakody also states that Letterer-Siwe disease, Hand-Schüller-Christian disease and this eosinophilic granuloma of bone should be grouped as variants of a basic disease process although clinically no common denominator can be found.

Ray and Kellner [253] report eosinophilic granuloma of the clavicle in an aviation cadet 22 years old. The patient gave a history of enlargement and tenderness of the medial end of the clavicle of four weeks' duration. Surgical excision was done after biopsy. Recovery was uneventful.

Arnold [254] reports a case of eosinophilic granuloma in the distal part of the clavicle of a woman 37 years old. A roentgenogram of the chest showed a soft, universally distributed mottling of both lungs, suggestive of lymphogenous spread of a metastatic tumor or of infection. Curettage of the lesion of the bone and roentgen irradiation of the pulmonary lesion eliminated all clinical and roentgenologic evidence of the disease for the time being at least.

[Ed. Note.—This case bears a close similarity to several cases of Hand-Schüller-Christian disease which we have encountered, in which there was similar involvement of the lungs. With the increasing knowledge of eosinophilic granuloma, there seems to be a tendency among the profession to group it with Hand-Schüller-Christian disease and Letterer-Siwe disease.]

NEUROFIBROMATOSIS

Hagelstam [255] discusses in general the characteristics of multiple neurofibromatosis and especially the skeletal changes which are connected with it. He collected 150 cases of spinal deformities in neurofibromatosis from the literature, which he analyzed in detail. He includes the description of a case of multiple neurofibromatosis with severe dorsolumbar kyphoscoliosis in a girl 14 years old. A strange

252. Bakody, J. T.: Eosinophilic Granuloma of Bone with Report of a Case, J. Iowa M. Soc. **36**:397-400 (Sept.) 1946.

253. Ray, R. B., and Kellner, A.: Eosinophilic Granuloma of Bone: Report of a Case Involving the Clavicle, J. Bone & Joint Surg. **28**:629-634 (July) 1946.

254. Arnold, H. L.: Eosinophilic Granuloma of Bone: Preliminary Report of Case Complicated by Lung Lesions, Proc. Staff Meet. Clin., Honolulu **12**:183-185 (Sept.) 1946.

255. Hagelstam, L.: On the Deformities of the Spine in Multiple Neurofibromatosis (von Recklinghausen), Acta chir. Scandinav. **93**:169-193, 1946.

hourglass-shaped deformity of the area from the third to the first lumbar vertebra was found in the roentgenogram. Hagelstam concludes that this strange vertebral deformity may have originated as a neurotrophic disturbance in the growth of normal vertebrae.

Böhringer [256] presents a case of neurofibromatosis in a man 36 years old. The patient's father and sister had the same disease. In Böhringer's case the lesions became malignant and metastasized over a period of several years and after multiple operations. The changes found in the organs of internal secretion are considered to be due to trophic disturbances. The skeletal anomalies were congenital malformations, Böhringer states, rather than sequelae of nerve disturbances. He points out the connection between hypertrophic neuritis and neurofibromatosis.

Norley, Ghormley and McDonald [257] report that neurofibromas undergo sarcomatous transformation in about 13 per cent of cases. Neurofibromatous tissue has been found in bone marrow. They present a case of neurofibroma associated with fibrosarcoma of the leg which involved the soft tissue, periosteum and bone. The most unusual feature of this case is the finding of a neurofibroma of the medullary cavity of the bone of the same leg.

[ED. NOTE.—Norley, Ghormley and McDonald's case is another link in the evidence that nerve tissue does exist in bone.]

LIPOMA

Regan, Bickel and Broders [258] present 2 cases of benign lipoma of the extremities which illustrate the peculiar tendency of some of these tumors to infiltrate muscle; in 1 case a tendency to recurrence also is shown. Careful scrutiny of numerous microscopic sections of the tumors removed from both patients revealed no evidence of malignant change.

[ED. NOTE.—Encapsulated lipomas of the extremities are frequently seen, but to find apparently adult fat tissue infiltrating muscle is rather unusual. These lesions are usually slowly progressive and in time may replace the muscle fibers and assume rather enormous proportions of their own.]

256. Böhringer, H. R.: Neurofibromatosis mit maligner Entartung; Beitrag zur Differentialdiagnose der Neurofibromatosis und der hypertrophischen Neuritis, Schweiz. med. Wchnschr. **76**:366-371 (April 27) 1946.

257. Norley, T.; Ghormley, R. K., and McDonald, J. R.: Neurofibromatosis with Sarcoma of Leg: Report of Case, Proc. Staff Meet., Mayo Clin. **20**:478-481 (Dec. 12) 1945.

258. Regan, J. M.; Bickel, W. H., and Broders, A. C.: Infiltrating Benign Lipomas of the Extremities, West. J. Surg. **54**:87-93 (March) 1946; abstracted, Proc. Staff Meet., Mayo Clin. **21**:175-176 (April 17) 1946.

Simon and Senturia [259] describe a typical encapsulated lipoma of the thigh with a typical roentgenologic appearance in a Negro soldier 25 years old. This tumor was easily excised.

Moulonguet [260] discusses the diagnosis of deep encapsulated lipomas and points out that it can be made, especially by roentgen examination. He refers to Destinger's report of 2 cases in which amputation has been carried out because a malignant lesion was suspected. This later proved to be a lipoma. Moulonguet reports 3 cases. In the first a large lipoma was situated in the thigh underneath the quadriceps but was free from the femur; in the second and third cases the lipomas were in the forearm and had periosteal attachments.

Williford and Fatherree [261] present a case of diffuse bone tumor involving the pelvis, with metastasis to the regional lymph nodes and to the chest. Pathologically they consider it to be a primary liposarcoma of bone. The microscopic examination revealed many cells varying from polygonal to rounded or elongated, with an occasional rare mitotic figure.

[ED. NOTE.—This is an exceedingly rare bone lesion.]

AMELOBLASTOMA

Williams and Marcks [262] report a case of ameloblastoma of the mandible in which removal of the tumor and bone grafting were performed.

Byars and Sarnat [263] give a brief review of dental histogenesis which they consider facilitates the understanding of the origin not only of ameloblastoma but also of other dental anomalies. They state that roentgenograms are most valuable in the diagnosis of early ameloblastoma; if recognized early, the tumors can be most easily removed without serious deformity. There are no constant characteristic roentgenographic findings. The final diagnosis must depend on microscopic findings. The authors discuss both the gross and the microscopic findings and state that the treatment of this type of tumor is primarily surgical. In many cases a definite preoperative diagnosis is not possible. Both the intraoral and the extraoral surgical approach

259. Simon, H. E., and Senturia, H. R.: Intermuscular Lipoma of the Thigh with Roentgenologic Findings, South. M. J. **39**:624-626 (Aug.) 1946.

260. Moulonguet, P.: Lipomes profonds des membres: Lipomes périostés, Mém. Acad. de chir. **72**:301-303 (May 22-29) 1946.

261. Williford, H. B., and Fatherree, T. J.: Primary Liposarcoma of Bone: Report of a Case, U. S. Nav. M. Bull. **46**:1750-1755 (Nov.) 1946.

262. Williams, P. E., and Marcks, K. M.: Ameloblastoma of the Mandible: Report of a Case, J. Oral Surg. **4**:133-144 (April) 1946.

263. Byars, L. T., and Sarnat, B. G.: Surgery of the Mandible: The Ameloblastoma, Am. J. Orthodontics **32**:34-46 (Jan.) 1946.

are discussed, and electrocautery of the contaminated base in the bone is recommended. When resection of a portion of jaw is done, some attempt should be made to maintain the fragments of the jaw in their proper position. A brief discussion of bone grafting is given.

[ED. NOTE.—This article is recommended for those interested in the subject.]

MISCELLANEOUS ARTICLES OF INTEREST

Nissen [264] discusses 3 cases in which tumors of the lower end of the femur and of the upper end of the tibia were treated by resection of the bone and the respective defects were partially replaced by use of half of the adjoining upper or lower third of the tibia or femur.

Stout [265] discusses rhabdomyosarcoma of the skeletal muscles and states that it is rather rare and that little information about it has accumulated in the past ninety years.

Microscopically, rhabdomyosarcoma is characterized by the presence of some giant cells and strap-shaped and racquet-shaped cells in which it is sometimes possible to demonstrate cross striations and longitudinal myofibrils. The giant cells have peripherally arranged vacuoles that cause them to resemble a spider or a spider's web. The cytoplasm of these cells is more or less strongly acidophilic. Grossly the tumors are of variable size and are adjacent to or situated in muscles in various parts of the body but most commonly in the thigh and leg. They are not likely to be extremely hard, and invariably they infiltrate insidiously and metastasize through the blood and the lymph channels. Pulmonary metastasis is common. In 108 of the 121 cases reported treatment was given. Only 4 patients lived for five years. Stout states that if this tumor is to be cured more often it is evident that extensive removal of the primary growth must be done earlier and more drastically, with greater sacrifice of grossly healthy tissue about the growth.

Jackson and Balkin [266] review the early work done on glomus tumors and state that normal glomus units have been found in all warm-blooded animals. They present 1 case, in which a Negro 68 years old had a small tumor on the left forearm for twenty-five years. It measured 4 cm. in diameter and is the largest glomus tumor reported. It was cured by excision done under local anesthesia.

---

264. Nissen, R.: Replacement of Lower End of Femur or Upper End of Tibia, J. Internat. Coll. Surgeons **9**:56-61 (Jan.-Feb.) 1946.

265. Stout, A. P.: Rhabdomyosarcoma of the Skeletal Muscles, Ann. Surg. **123**: 447-472 (March) 1946.

266. Jackson, H., and Balkin, R.: Glomus Tumors (Angioneuromyomas): A Clinical and Pathologic Report of an Unusual Case, Arch. Surg. **53**:100-104 (July) 1946.

Cammermeyer [267] reports a case of congenital tumor of the tactile end organ (glomus tumor) in a man aged 50 years. He states that these tumors are rare and presents a brief review of the literature.

Mayrhofer [268] reports a case of chondromatosis of bursa. He states that since the first description of chondromatosis of joints by Reichel in 1900 he could find only 4 cases of chondromatosis of bursa in the literature. In the first case there were chondromatous masses in the bursa in the biceps tendon in front of the shoulder joint. In 2 cases the lesions were in the bursa below the head of the gastrocnemius muscle, and in the last case they were in the ileopectineal bursa. Mayrhofer reports a case of isolated chondroma in the bursa of the internal obturator muscle in a woman 74 years old. As to the cause, he points out the possibility of erroneous differentiation of the mesenchyma. This concept finds support in the simultaneous appearance of a lipoma near the bursa in his case. The importance of trauma also is discussed.

Soubigou [269] reports a case of xanthoma in the right knee of a man 31 years old. The tumor appeared four months after traumatic hemarthrosis of the same knee. The tumor was removed by arthrotomy, and a diagnosis of granuloxanthomatous synovitis was made. This is a rare diagnosis, and up to 1939 only 35 cases can be found in the literature.

Hertzog and Hayford [270] report a case of diffuse myxoma of the lower extremity in a white woman 25 years old. Her weight normally was about 115 pounds (52.2 Kg.). A high amputation of the thigh was done, and the amputated extremity weighed 60½ pounds (27.4 Kg.). The amputation was done through neoplastic tissue, as the diffuse myxoma had invaded the pelvis on this side. This case is reported as a medical curiosity.

---

267. Cammermeyer, J.: Tumor of Tactile End Organs, Arch. Path. **42**:1-11 (July) 1946.

268. Mayrhofer, O.: Zur Chondromatose der Schleimbeutel, Wien. klin. Wchnschr. **58**:291-294 (May 31) 1946.

269. Soubigou, X.: Sur un cas de xanthomatose de la synoviale, Rev. méd. nav. **1**:59-61, 1946.

270. Hertzog, A. J., and Hayford, W. D.: Diffuse Myxoma of Lower Extremity with Elephantiasis, Minnesota Med. **29**:1017-1019 (Oct.) 1946.

REVIEW OF UROLOGIC SURGERY

ALBERT J. SCHOLL, M.D.
LOS ANGELES
FRANK HINMAN, M.D.
SAN FRANCISCO
EDMUND CROWLEY, M.D.
LOS ANGELES
ALEXANDER B. HEPLER, M.D.
SEATTLE
ROBERT GUTIERREZ, M.D.
NEW YORK
GERSHOM J. THOMPSON, M.D.
AND
EDWARD N. COOK, M.D.
ROCHESTER, MINN.
AND
VINCENT J. O'CONOR, M.D.
CHICAGO

KIDNEY

Surgery.—Brogan[1] diagnosed an embryoma of the kidney at birth and successfully removed it seventy-two hours later. The tumor, which weighed 239 Gm., had displaced the heart to the right side of the chest. No tissue resembling the kidney could be identified. The child left the hospital on the twentieth postoperative day. Fifteen weeks later the child gave no evidence of recurrence and had made a good gain in weight.

Anomaly.—Abeshouse[2] discusses crossed ectopia with fusion and presents a review of the literature, with a report of 4 cases. The total of such cases reported to date is 337; however, this anomaly is encountered about once in every 7,500 necropsies. The six anatomic varieties, presented in order of relative frequency, are (1) elongated with ectopic kidney in inferior position; (2) sigmoid (S shaped); (3) L (transitional form); (4) disk (fusion of medial borders); (5) lump (irregular fusion) and (6) elongated with ectopic kidney in superior position.

The clinical symptoms of crossed ectopia with fusion are modified by the size and location of the anomaly, the presence of associated pathologic lesions in one or both renal components and associated lesions

1. Brogan, R. E.: Successful Nephrectomy in a Three-Day Old Infant, Journal-Lancet **67**:274-277 (July) 1947.

2. Abeshouse, B. S.: Crossed Ectopia with Fusion, Am. J. Surg. **73**:658-683 (June) 1947.

of congenital or acquired nature in adjacent structures. The predominant symptoms are pain and a palpable mass and, less frequently, urinary symptoms, which usually are due to infection in the anomalous kidney. The crossed ectopic kidney is more susceptible to pathologic processes than the noncrossed kidney.

Surgical treatment of the condition is either conservative or radical and depends on (1) the nature and severity of symptoms, (2) anatomic relationships of the renal anomaly, (3) pathologic changes in the renal anomaly and (4) the general condition of the patient. Conservative operations, such as combined symphysiotomy and nephropexy, may have value in cases presenting no significant pathologic changes. Radical surgical procedures consisting of removal of one renal component are the operation of choice in the majority of cases.

Neoplasms.—Bourgeois [3] states that renal tumors in children are usually of the Wilms type. Occasionally, however, benign tumors or teratomas are encountered. The histologic nature of such tumors is complex and not well known. For this reason, Bourgeois reports a case observed by him, that of a girl 7 years of age. Examination revealed the patient to be of less than normal weight. She was pale and had slight dyspnea. Her abdomen was moderately distended, and a tumor could be palpated in the left flank. Bimanual palpation revealed a hard mass the size of an orange, slightly movable and extending beyond the midline but painless. The growth extended upward to the ribs and seemed to be in contact with the spinal column. The urine contained a trace of albumin and a few bacteria. Roentgenologic examination after a barium meal showed that the stomach was displaced to the right by the tumor, which formed a round opaque shadow in the renal region. Cystoscopy, pyelography and roentgenologic examination indicated the presence of a calcified cyst of the left kidney. At operation the tumor was densely adherent to the kidney. Hard and soft nodules could be palpated. There was no demarcation between the tumor and the renal parenchyma. Because of the doubt as to the nature of the neoplasm, total nephrectomy was done. Exploration revealed no lymphatic involvement.

The vascular pedicle was ligated according to the method of Leguèu, and the ureter was divided between ligatures. The tumor was then removed en masse and the wound sutured in 3 layers; 2 cigaret drains were left in the renal bed. The postoperative course was uneventful, and two years later the patient was in excellent condition. The histologic nature of the tumor is described in detail, and the findings are interpreted as indicating a primary reticulo-

3. Bourgeois, P.: Réticulo-sarcome primitif du rein, Union méd. du Canada **75**:1427-1437 (Nov.) 1946.

sarcoma of the kidney. On review of the roentgenograms in this case, it was noted that the shadows were denser than those in solitary cysts of the kidney. The deformity of the calyx as shown in the pyelogram eliminated an infiltrating lesion. The author emphasizes the rarity of these tumors. He had not seen another in thirteen years.

Graham[4] reviews a series of 195 cases of malignant lesions of the kidneys. The initial symptom in 70 per cent of the cases was hematuria or pain or both; in 31 per cent, or about a third, hematuria only was present. The finding of a palpable mass in 41 per cent of the cases at initial examination indicated that the diagnosis of malignant lesion of the kidney was made late in the course. Blood in the urine and palpation of a lesion were the main initial clinical findings. Sixty-six per cent of the pyelograms gave diagnostic information. Evidence of compression of one or more calyces and distortion or compression of the pelvis made up 81 per cent of the significant pyelographic findings. Intravenous pyelography gave diagnostic information in only 16 per cent of cases in which it was employed. Eighty-six per cent of the tumors were considered to arise in the parenchymal portion and 14 per cent in the pelvic or calyceal portion of the kidneys. The squamous cell tumors did not metastasize widely, whereas the transitional cell neoplasms metastasized extensively to many organs and structures. Sixty per cent of the transitional cell tumors had become implanted in the ureter or bladder during the period of observation or previously. Metastatic lesions were found in 70 cases (36 per cent) at the time of the initial examination. Forty-eight per cent of these were in the lungs, 23 per cent in bone, 9 per cent in the liver and 7 per cent in the brain. Bones most prevalently affected were the vertebrae, ribs and pelvis. Since 41 per cent of the patients had inoperable lesions at the time of their admission to the hospital, indications are that not much has been accomplished toward early diagnosis of malignant lesions of the kidney, at least in the group of cases encountered by the author. In an additional 21 cases metastatic lesions were found at the time of operation, and the lesions in 8 were found to be inoperable because of local extension. Of the 195 patients, only 77 finally had the involved kidney and tumor removed at the Hines Memorial Hospital or at the referring hospital. This is a result of late diagnosis. Forty-two patients who underwent nephrectomy and are known to be dead lived an average of twenty-three months after operation. Thirty-eight per cent lived less than one year, and 26 per cent lived one to two years. The operative mortality was 11 per cent in the 60 cases in which operation was performed in the Hines Memorial Hospital. This relatively high figure is due to the fact that

4. Graham, A. P.: Malignancy of the Kidney: Survey of One Hundred and Ninety-Five Cases, J. Urol. **58**:10-21 (July) 1947.

difficult problems are encountered in the hospital, that is, the cases encountered are those in which physicians in other hospitals do not elect to undertake the operation.

Of 15 large tumors which were treated by preoperative irradiation at this hospital, 5, or a third, showed some demonstrable reduction in size. This was produced at the cost of delayed healing of the incision. The idea of shrinking a massive renal tumor to operable size with roentgen rays is a moot question. Irradiation was administered in 44 inoperable cases. All the patients were dead within a year and four months, the average duration of life being five months. Although in many instances the condition was almost terminal at the start of treatment, yet it is seen that prolongation of life was not remarkable in any case.

Among the patients operated on who are alive and well there were 28 per cent three year "cures," 17 per cent five year "cures," and 14 per cent ten year "cures."

Diagnosis of malignant tumor of kidney in cases in which genitourinary study was undertaken was missed in 16 cases (8 per cent of the entire series studied). In 26 (13 per cent) no genitourinary study was made and the diagnosis of tumor of the kidney was not made until the time of necropsy. In 23 of these the lesions were "silent," that is, they produced no symptoms referable to the genitourinary tract. This was 11 per cent of all cases reported. In the average case about one year and eight months elapse from the date of first symptoms until genitourinary study is made.

Berne-Lagarde[5] presents an analysis of immediate postoperative and late results of nephrectomy for malignant lesions of the kidney in adults based on the study of cases reported from 1903 to 1937. From a mortality rate of 60 to 70 per cent before 1890 and 22 per cent in 1920, there was a drop to 10 per cent in 1938. This reduction in the death rate is attributed to improved methods of exploration, which permit diagnosis at a time when hematuria is the only symptom, to better preoperative and postoperative care of the patients and to improved surgical technic. Careful attention to the condition of the heart previous to operation is urged. Sudden death from embolism may be prevented by ligation of the renal pedicle before liberation of the kidney. Duodenal fistula is usually fatal, but colic fistula frequently heals spontaneously. Injuries to the aorta are rare but injuries to the vena cava are common, especially in the presence of pyonephrosis. Severe pain is of such prognostic significance that it sometimes is a contraindication to operation. Fever usually indicates a higher grade of malignancy and a more rapid course and has thus an unfavorable prognostic significance.

5. Berne-Lagarde, R. D.: Les resultats de la nephrectomie pour cancer chez l'adulto, in Trente-neuvieme congrès français d'urologie, October 1945, pp. 1-91.

Lymphatic invasion cannot be judged by the duration or size of the tumor, since small tumors may be associated with extensive adenopathy and vice versa. The lymphatic involvement is not always neoplastic. Systemåtic removal of the glands increases the immediate operative risk without improving late results, and their removal is permissible only when it can be easily accomplished without risk of vascular injury. Extension to the renal vein favors early metastasis. The number of survivals is three times as great when the renal vein is not involved. Intravenous neoplastic thrombi favor early metastasis, but the prognosis is far from fatal. No prognostic criteria can be gained from the histologic findings per se, although hypernephroma is less malignant than renal epithelioma and the course of cystic carcinoma is extremely slow. Recurrences develop earlier in carcinoma than in sarcoma or hypernephroma. Local recurrent lesions may be removed surgically while small, but the prognosis is poor if they are located in the renal bed. Metastasis increases in frequency with duration of the disease, but the time of onset and the incidence are frequently independent of the size of the lesion. Early metastasis may follow removal of small tumors, and long periods of survival have been reported after removal of large tumors. Pulmonary metastasis is a contraindication to nephrectomy. Most metastatic lesions develop in the first four years, the majority within the first twenty-four months. If a metastatic lesion is the first clinical sign of renal carcinòma, it should be removed, and then nephrectomy is indicated. Patients whose tumors have been in the superior pole of the kidney live the longest after operation. The survival rate is much higher in cases in which hematuria is the only presenting symptom than in cases in which hematuria associated with tumor is the presenting complaint. The prognosis is poor in cases in which tumor is the only presenting symptom. Real cure following nephrectomy is rare, but survival for many years has been reported.

Large fixed tumors are usually considered inoperable, but the actual extent and degree of fixation of the tumor can be determined only at operation. Adhesions to the diaphragm, especially on the left side, are a contraindication to operation. Numerous dense adhesions have the same significance.

To reduce the mortality rate, limitation of the indications for nephrectomy is urged. There are, however, no fixed rules since large tumors may be nonadherent and adhesions when present may not be of neoplastic origin.

The ideal treatment is removal of the kidney and its adipose covering en bloc as well as the nearest lymph nodes. The transperitoneal route is not favored in France. Fey's incision gives an excellent exposure of the upper part of the kidney and is, therefore, useful. Wide lumbar

exposure is the best and most used route. In order to prevent dissemination, great care must be exercised not to break the tumor in removing it.

It is emphasized that the transperitoneal route, even with improved methods of combating infection, is twice as dangerous as the lumbar route. The mortality rate is more than three times as high in the hands of general surgeons as in the hands of urologists. Routine extirpation of the suprarenal capsule is not recommeded. Early diagnosis and early removal remain the most efficient weapons against this disease.

Tuberculosis.—Farneti[6] reports 3 of his own cases of tuberculosis of the renal papillae and 19 from the literature. He states that this condition has distinct pathologic features and pathogenesis and that tuberculosis of the kidney may be limited to the pyramidal apex. In his opinion tuberculous renal papillitis deserves more attention than has been directed to it heretofore. The tubercle bacilli from the blood can easily lodge in the fine capillaries of the pyramidal apex. Infection of the pyramid follows, with parietal tubercles forming in the papillary vessels. In his cases Farneti is of the opinion that a primary infection of the papillae was transmitted from the blood or urine. The initial lesion diminishes the caliber of the collecting tubules and orifices in the cribrosa, leading to compression and distention, with a deleterious effect on the rest of the uriniferous tubules of the pyramid. Incrustation with calcium favors lodging of bacilli in the papillae (Aschoff's elimination tuberculosis). The symptoms of tuberculosis of the renal papillae are like those of renal tuberculosis in general. The hematuria is likely to be severe owing to the rich vascularity of the papillae. Cystoscopy frequently will reveal lesions of the bladder at the ureteral orifices which are of diagnostic significance and a positive bacillary finding on ureteral catheterization. Differential diagnosis is difficult since there are no characteristic symptoms. The symptoms seem relatively benign in proportion to the extent of the lesion. In cases in which the urea content of the renal urine is high and marked symptoms are present without enlargement of the kidney, this condition should be considered. Pyelography yields little information. Only exploratory nephrotomy can be expected to reveal the true condition. Failure to operate in the early stages may lead to diffusion to the rest of the kidney or to the opposite kidney. If the opposite kidney is normal, nephrectomy is the treatment of choice. Otherwise partial resection or exploratory nephrotomy may be tried or the wound may be closed without any further surgical procedure.

---

6. Farneti, F.: Contributo allo studio della tuberculosi delle papille renali (studio clinico ed anatomo-patologico di tre osservazioni personali), Arch. ital. di urol. **21**:201-232, 1946.

Aneurysm.—Pearse and MacMillan[7] report a case of renal arteriovenous aneurysm. The patient, a white man 60 years old, came under observation because of gross hematuria. Retrograde pyelograms showed a filling defect of all the calyces of the left kidney which was suggestive of early hypernephroma or cystic disease of the kidney. The kidney was explored and removed through a transperitoneal incision. A vibratory thrill was felt in a large vessel as it crossed the pelvis to enter the hilus. Careful dissection revealed an aneurysm of both the renal vein and the artery, with an arteriovenous communication.

Hypertension.—Cibert and his associates[8] state that hypertension in cases of unilateral surgical disease of the kidney is nothing new but is exceptional. Braasch found unilateral surgical disease of the kidney responsible for hypertension in only 2.5 per cent of 4,000 cases. Nephrectomy was found justifiable in only 19 cases, or less than 0.5 per cent of cases of hypertension in general. In France unilateral surgical disease of the kidney is found to be even more rare as a cause of hypertension, possibly because only cases in which considerable subjective symptoms are present were considered. Any surgical disease of the kidney may give rise to hypertension. Among the renal conditions associated with hypertension may be mentioned atrophic, unilateral pyonephrosis, renal tumor, renal calculi with secondary infection, hydronephrosis, tuberculosis and polycystic kidney. Among the rarer causes of hypertension are listed large cysts, renal infarcts, acute cortical infection, paranephric tumors, compression or obliteration of the renal arteries, perinephritis, renal trauma and renal ptosis. The authors state that tuberculous hydronephrosis is the most common cause. The mechanism of production of hypertension is discussed, with a complete review of the authors' cases and of those reported in the literature.

The authors conclude that the efficacy of nephrectomy in these cases cannot be questioned. It should be done early. Failure of the operation may be attributed to too late intervention when sclerosis of the second kidney has developed. These changes are reversible in the earlier stages. Nephrectomy should be done more frequently to save patients with otherwise incurable hypertension. Routine urography is indicated in all cases of hypertension in which renal colic, cystitis, pyuria, hematuria or urologic signs such as pus or blood in the urine have occurred. When palpation reveals a large kidney, urography should be done. A simple roentgenogram is recommended for patients less than 50 years of age, as this will reveal renal atrophy or a large kidney masked by obesity.

---

7. Pearse, R., and MacMillan, R. L.: Congenital Arteriovenous Aneurysm of the Renal Artery, J. Urol. **58**:235-238 (Oct.) 1947.

8. Cibert, J. J.; Perrin, S., and Rolland, F.: Le traitement chirurgical des lesions unilaterales des reins dans l'hypertension et les nephrites, Lyon chir. **42**: 158-173 (March-April) 1947.

Surgical intervention is indicated only if the lesion is unilateral and not of too long duration in persons less than 50 years of age without advanced retinal lesions. Roentgenograms and intravenous urography are recommended for patients with hypertension and patients with Bright's disease unless there is notable azotemia, in which case the opaque medium is not excreted. Routine roentgenography and urography are indicated in cases in which urologic manifestations or tuberculosis has been present. It must be kept in mind that occasionally hypertension is merely coincidental with renal lesions and not dependent on them. In such cases hypertension may persist in spite of nephrectomy, as in cases in which the operation was performed too late, i. e., after irreversible changes had taken place. The value of Schwartz and Findlay's method of foretelling the effect of nephrectomy by double sympathetic block can be determined only by future studies. Unilateral or predominantly unilateral nephritides may cause hypertension. There may be painful or hematuric unilateral nephritis. Surgical lesions also may cause unilateral nephritis. These cases are exceptional, but recognition and proper treatment will lead to cure of otherwise incurable hypertension.

Le Clerc-Dandoy[9] discusses unilateral renal hypertension. Experimentally, slow progressive constriction of a renal artery has produced hypertension in dogs. Removal of the ischemic kidney will restore the blood pressure to normal. A hypothetic substance, known as renin or hypertensin, is supposed to be liberated by the kidney and acts on the tonus of the arterioles. In human beings kidneys affected by chronic pyelonephritis might correspond to the ischemic kidney of the laboratory animal. Hypertension is not the rule in such instances and if present may be purely coincidental, but when hypertension subsides promptly after nephrectomy and the patient remains normal for several years, it seems justifiable to consider the affected kidney as the source of the hypertension.

The assumption of a renal origin of the hypertension is justifiable only when the renal lesion precedes the onset of hypertension, when the other kidney is perfectly normal and when the blood pressure falls to normal limits after nephrectomy and remains there for at least four years. The case of a man 24 years of age was reported; he had suffered from hydronephrosis on the right side since he was 10 years of age. Renal function was normal. A pyeloureteral plastic procedure was considered but was refused because of improvement in symptoms. Four years later the patient was still suffering from attacks of pain in the right region of the hypochondrium and also complained of headache

9. Le Clerc-Dandoy, V.: Hypertension curable per la nephrectomie, in Quarantieme congrès français d'urologie, October 1946, pp. 229-232.

and vertigo. Nephrectomy was performed on the right side. Six weeks after operation the blood pressure had returned to normal, and it has remained so.

URETER

Transplantation.—Cibert and Perrin [10] state that deviation of the urine to the iliac region deserves greater consideration in the treatment of tuberculous cystitis, particularly in patients who have undergone nephrectomy. Their observations are based on a study of 41 cases. Hitherto cutaneous ureterostomy has been performed only as a last resort in spite of the fact that it carries practically no risk and the technic is simple. Complicating necrosis, constriction, fistula or calculi may require another operation, but a kidney with a cutaneous ureter has been known to survive as long as nineteen years.

The Richer enervation operation does not yield constant results and only relieves pain due to urgency, distention and cramps caused by transitory retention. The results are due to diminution of motility of the bladder rather than of its sensibility. There is less difficulty in changing the tubes after cutaneous ureterostomy than after nephrostomy, and the patient is more independent. Nephrostomy is indicated in the rare cases in which ureterostomy is contraindicated, such as cases in which severe periureteritis prevents exteriorization or stenosis interferes with passage of the tube. Bacillary cystitis is a contraindication to the Coffey operation. It is only rarely that the ureter is found normal in tuberculous cystitis, and in such instances ureterostomy is contraindicated, since the pathologically dilated ureter is more easily treated than the normal ureter.

Other indications for ureterostomy include stubborn constriction and posterior fistula. The operation is especially recommended for preservation of the remaining kidney from the effects of persisting vesical lesions after nephrectomy. The only practicably possible treatment of a remaining kidney for ureterohydronephrosis due to cystitis is ureterostomy. The question of the optimal time for operation is a delicate one. If it is carried out too late, the intervention hastens the end. After properly timed ureterostomy, insomnia, pain and symptoms of renal insufficiency subside and the patient is soon able to resume his occupation. If the remaining kidney is tuberculous, the good results of operation are only transitory, but the patient is rendered more comfortable by elimination of stasis leading to uremia. When ureterohydronephrosis is the sole cause of renal deficiency, ureterostomy performed before irreversible changes have taken place may lead to lasting improve-

10. Cibert, J., and Perrin, Jr.: Indications de l'ureterostomie cutanée dans le tuberculose urinaire, in Trente-neuvieme congrès français d'urologie, October 1945, pp. 317-327.

ment or even cure. The presence of ureterohydronephrosis after nephrectomy can be detected by urographic surveillance, and cutaneous ureterostomy may thus serve to prolong life in patients with bilateral renal tuberculosis or to prevent the lesion from becoming bilateral in other cases.

Obstruction.—Davis [11] considers that in the future nephrectomy for hydronephrosis must be reserved for use in cases in which damage is extreme and irreparable. In his experience intubated ureterotomy is superior to any type of plastic operation on either the upper part of the ureter or the ureteropelvic junction. His article is illustrated with drawings showing his technic for correction of obstruction and pyelograms taken before and after operation.

Stone.—Hamm [12] gives a review of 255 cases of ureteral calculus and evaluates the important symptoms. The importance of a complete urologic survey in each instance of renal colic to determine the size and location of the calculus and to exclude associated renal disease has been pointed out. Careful studies should be made to determine the cause of calculi, and follow-up study is required to be sure that all factors are eliminated. Conservatism in the management of the cases has been stressed. The multiple catheter and the catheter loop have been the instruments employed for cystoscopic manipulation in the majority of cases. Ureterolithotomy was performed in 40 cases, including 1 of bilateral stones. Surgical intervention when indicated should be performed promptly. The hospital mortality rate following this type of operation is exceedingly low. No deaths occurred among patients who underwent ureterolithotomy.

BLADDER

Neoplasms.—In endometrioma of the bladder involvement may occur in two ways: (1) by direct extension from endometriosis of other pelvic organs and (2) by arising in the bladder itself. The tumor primarily is confined to the muscular wall but later may invade the epithelial lining. It is not encapsulated and at operation may be mistaken for carcinoma. Symptoms are usually characterized by cyclic attacks of frequency of micturition, dysuria and suprapubic pain. If the mucosa is involved, hematuria will occur at the time of the menstrual period. Treatment depends on (1) the age of the patient and (2) whether the ureteral orifices are involved. Among patients more than 40 years of age, castration by irradiation usually will be followed by regression of the tumor and disappearance of symptoms. For young

11. Davis, D. M.: Ureteral Obstruction: Recent Advances in Its Embryology, Nosology and Surgery, Brit. J. Urol. **19**:71-82 (June) 1947.

12. Hamm, F. C.: Ureteral Stone, Brooklyn Hosp. J. **5**:132-144 (July) 1947.

persons radical resection may be preferable. If the ureteral orifice is involved, partial cystectomy and reimplantation of the ureter may be necessary.[13]

Marshall [14] reports results of 207 ureteral transplants by the Coffey I intraperitoneal method on 104 patients. Ninety-six of the patients had vesical tumors. Thirteen patients died in the immediate postoperative period, and a total of 33 have now died. Seventy-one were living at the time of the report from one to fifty-six months after operation. Temporary nephrostomy was necessary for 3 patients, and a fourth is wearing nephrostomy tubes during convalescence from cystectomy. In 1 case it was necessary to remove the kidney. One ureter was successfully transplanted into the bowel a second time. Three patients have had one or both ureters transferred from the bowel to the skin. Thus of 207 operations for transplantation of a ureter, 34 were immediate failures but 173 (84 per cent) were early successes. Of the 104 patients treated, 31 per cent are known to be dead, a fourth have had mild troubles, an eighth have had severe complications and an eighth have died of complications. The palliative results were so good that no differentiation was made between good and bad surgical risks. Marshall is of the opinion that total excision of the bladder is not a difficult or dangerous operation; there were only 2 deaths (2.5 per cent) in more than 77 cases.

However, the real surgical problem is the satisfactory permanent diversion of the urinary stream as a prerequisite to cystectomy. Transplantation of the ureters to the bowel and total cystectomy constitute a formidable undertaking even for well trained surgeons and carry a postoperative mortality of at least 10 to 20 per cent. Before such a surgical program is advised, the surgeon should have definite reasons in mind.

It is possible to cure carcinoma of the bladder by irradiation, and therefore such treatment cannot be totally abandoned although on a large scale basis the results are poor. The average period of survival was twenty-four and a half months for a group of 316 patients treated by irradiation with a complete follow-up record of three years or more compared with an average survival of twenty months for 33 patients who had undergone resections of the bladder for neoplasm. Marshall's results following local destruction of malignant tumors of the bladder were unsatisfactory although temporary palliative benefits were noted. At best the situation in carcinoma of the bladder is unsatisfactory. Without treatment, about 10 per cent of patients have been reported

13. MacLeod, D.: Endometriosis: A Surgical Problem, Brit. J. Surg. **34**:109-116 (Oct.) 1946.

14. Marshall, V. F.: Transplantation of the Ureters and Total Cystectomy, J. Urol. **58**:244-249 (Oct.) 1947.

to survive five years, and, though none are cured and morbidity is not avoided, no morbidity is added.

Stone.—Abramson [15] presents 7 cases of vesical calculi among paraplegic patients in whom irrigations with solution G (citric acid [monohydrate], 32.3 Gm.; anhydrous magnesium oxide, 3.1 Gm.; anhydrous sodium carbonate, 4.4 Gm., and distilled water to make 1,000 cc.) produced disintegration of the calculi. The incidence of vesical calculi in 35 cases of paraplegia was 20 per cent. The method of treatment is outlined. The time necessary to dissolve these calculi ranged from six to forty-four days; the average time was fourteen days. Some of the other uses of solution G are discussed.

Cystitis.—Berry and Berry [16] describe in detail 3 cases of acute exudative cystitis from their series of 24 cases. The acute vesical condition is characterized by profuse bacterial pyuria and gross hematuria. The end result of the inflammatory lesion is a contracted and ulcerated bladder, with terminal ureteritis and pronounced dilatation of the upper part of the urinary tract. The authors consider that the condition is caused by an organism, possibly a spirochete, and has some relation to nonspecific urethritis. Differential diagnosis concerns the exclusion of gonorrhea, tuberculosis and malignant lesions. Familiarity with the symptoms and the urographic findings make the diagnosis simple. The use of neoarsphenamine and oxophenarsine hydrochloride seems to give improvement.

Irradiation Reactions.—Watson, Herger and Sauer [17] present a study dealing with irradiation reactions in the bladder after roentgen and radium treatment of female pelvic disease.

Of 5,990 patients treated during the twelve year period from 1933 through 1944, 164 (2.74 per cent) were known to have had changes in the bladder due to irradiation. Four patients had acute irradiation reactions and 160 patients late irradiation reactions.

A distinction depending on the severity of the lesion was made between three grades in both early and delayed reactions. Symptoms, cystoscopic appearance, diagnosis, treatment, clinical course and pathology of the various lesions were discussed.

It is suggested that a combination of four different factors is primarily responsible for the occurrence of late reactions to radium. These factors are (1) excessive irradiation dosage delivered, (2) individual

---

15. Abramson, D. J.: Solution of Vesical Calculi, J. Urol. **58**:29-33 (July) 1947.

16. Berry, J. V., and Berry, N. E.: Acute Exudative Cystitis of Undetermined Etiology, J. Urol. **58**:260-267 (Oct.) 1947.

17. Watson, E. M.; Herger, C. C., and Sauer, H. R.: Irradiation Reactions in the Bladder: Their Occurrence and Clinical Course Following the Use of X-Ray and Radium in the Treatment of Female Pelvic Disease, J. Urol. **57**:1038-1050 (June) 1947.

tolerance to irradiation, (3) anatomic variations and (4) faulty technic in the application of radium.

It is pointed out that the actual incidence of late reactions to radium is higher than can be determined because many patients die before reactions develop and others have lesions which are never discovered.

Incontinence.—Couvelaire [18] reports 16 cases of aponeurotic suspension of the neck of the bladder in the treatment of urinary incontinence. Two of his patients are males, and 14 are females. The operation on males is long and difficult, especially when the space between the ischia is narrow. For one man the operation was successful. For the second, incontinence in the recumbent position disappeared but incontinence in the upright position persisted. The results of aponeurotic suspension in the 16 cases are summarized as follows: complete failure in 1 case; imperfect result in 1 case in which operation was performed too recently to permit final evaluation; imperfect end result after a long period in 1 case; excellent results in 12 cases, and, finally, 1 death three months after operation. In 1 case a cervicovaginal fistula developed sixty-three days after operation but responded promptly to intervention via the perineum. Couvelaire concludes that aponeurotic suspension is a simple operation and gives more certain results than any other. It is of course contraindicated in cases of incontinence due to disease of the central nervous system. Suppurative hematoma may develop in elimination of the graft. Fistulas are probably attributable to excessive denudation of the neck of the bladder or too much tension on the aponeurotic flap.

In the female the operation is done via the vaginal and abdominal routes. The former is the essential stage, in which all the surfaces of the vesical neck are liberated. The cervical dissection is carried out in the planes of cleavage, and iodoform wicks are placed one in the right and the other in the left lateral cleavage. These serve as a guide for the abdominal stage of the operation and protect the adjacent cellular tissues. The vaginal end of the wick is covered with cellophane or a layer of rubber. The abdominal stage of the operation is facilitated by having the bladder moderately full and by the use of a bent forceps with a beak long enough to seize the free end of the graft.

The contraindications to this operation are (1) urinary incontinence due to disease of the central nervous system, (2) decided genital prolapse, (3) isolated large cystocele and (4) appreciable shortening of the ureter at previous operations.

The indications for the operation include (1) persistence of orthostatic incontinence after correct colpoperineorrhaphy, (2) failure of cer-

18. Couvelaire, R.: Considerations sur la technique, les indications et les résultats de la suspension aponévrotique du col vésical dans le treatment de l'incontinence d'urine, J. d'urol. **52**:234-238 (March 19) 1945.

vical constriction if not due to central causes, (3) orthostatic incontinence in nullipara with an intact perineum, (4) orthostatic incontinence associated with forced micturition and clear urine in which cervical liberation acts as enervation and (5) lasting incontinence following endourethral resection of the vesical neck or the prostate.

In 40 cases in which this operation was performed Michon observed no serious complications. Both partial and complete retention following the operation may yield to catheterization after a few days. The operation gives good results in women with deficient sphincters who have had one or two deliveries. Michon is of the opinion that aponeurotic suspension should be done in all cases in which Marion's classic operation has failed.

Millin [19] states that none of the operations suggested for the cure of urinary incontinence in the male has yielded satisfactory results. He suggests a simple intervention, which consists of exposing the bulbar portion of the corpora cavernosa and surrounding it by a band of chromic surgical gut. This leads to formation of fibrous tissue, permitting the corpora cavernosa to act as a pad and thus prevent urethral constriction. With the patient in position as for perineal prostatectomy, a no. 15 catheter is introduced into the bladder through the urethra. The lower halves of the scrotum are then fixed with forceps to the abdominal wall, and a median vertical incision is made through the perineum along the bulb from the perineoscrotal junction to the vicinity of the anus. Colles' fascia is incised and retracted to expose the bulb with its muscular sheath. The bulbocavernous muscle is split along the fold and the halves separated. The bulb is then liberated by sharp dissection as close as possible to the membranous urethra so that Kocher's forceps can be passed above it. A surgical gut band, 5/8 inch (1.6 cm.) wide, is turned ten times about the corpus spongiosum and the ends tied. The two halves of the bulbocavernous muscle are then sutured together as well as the two lips of Colles' fascia. The skin is closed without drainage, and the catheter is left in situ for five to seven days. In 2 cases a flap of fascia lata was used, but constriction of the urethra followed. The surgical gut band does away with this inconvenience as well as the necessity for femoral incision. Three illustrative cases are described which indicate that this method may prove successful in relieving various types of incontinence, such as incontinence following war wounds of the posterior urethra and rectum, incontinence following the punch operation, incontinence following congenital meningocele and incontinence following abdominoperineal removal of rectal carcinoma.

19. Millin, T.: Traitement chirurgical de l'incontinence d'urine chez l'homme, in Quarantieme congrès français d'urologie, October 1946, pp. 367-369.

Hock [20] gives an analysis of the cases of 20 women with moderate to severe stress incontinence. The ages of the patients ranged between 25 and 76 years, with an average of 48.6 years. The symptoms of 19 women were suggestive of irritation of the neck of the bladder, such as frequency, nocturia, dysuria, urgency and backache. Fifteen gave a history of deliveries, miscarriages or previous pelvic operations. The vesical neck and the urethra of 7 patients appeared normal, but in 12 they gave evidence of inflammatory changes. Cystoscopy was not performed in 1 case. Treatment consisted of urethral dilation and fulguration of the entire circumference of the vesical neck. Results of this conservative treatment were: cure in 8 cases, considerable improvement in 4 and slight or no improvement in 8. Since urinary continence is achieved by the sum total of all factors increasing the urethral resistance, a rational treatment of stress incontinence consists of the elimination of the cause of urethral relaxation. Surgical intervention is indicated for the correction of relaxation due to mechanical injury of the sphincters or the supportive structures of the urethra.

Reflex relaxation may arise from diseased organs such as the cervix or the fallopian tubes, but a more common source is the infected glands surrounding the vesical neck. It is often difficult to determine whether the incontinence is due to mechanical or reflex relaxation. In such instances it is advisable to begin with the simpler and less radical treatment of the urethritis. The neck of the bladder and the urethra may appear normal, and yet there may be an infection in the depth of the glands situated in the neck. Fulguration of the entire circumference of the vesical neck and the inflamed parts of the urethra should be done with a low power current. All polypoid formations should be destroyed. As a rule the patient is continent when she leaves the cystoscopy table after such treatment. The most likely explanation is that the stimulus of the fulguration causes the urethral glands to empty and thus the irritation of the nerve endings in which the reflex relaxation of the sphincters originates is reduced. A cure cannot be expected until all the glands are completely destroyed because symptoms recur if the glands become filled with secretion. The author has repeatedly observed much secretion emerging from the necks of the bladders of women during cystoscopy. This is due to the mechanical stimulation of the instrument. This observation explains the favorable results that often follow simple dilation of the urethra in cases of stress incontinence.

Studdiford [21] discusses the problem of stress incontinence and describes his method of correcting urethral prolapse by transplanting a strip of rectus fascia around the neck of the bladder. The effectiveness of the procedure depends on careful dissection and repair of the anterior

20. Hock, E.: Stress Incontinence, J. Urol. **57**:1069-1084 (June) 1947.

21. Studdiford, W. E.: The Problem of Stress Incontinence and Its Surgical Relief, Surg., Gynec. & Obst. **83**:742-750 (Dec.) 1946.

pubocervical fascia and on the reinforcement of this area by a fascial sling. Patients are selected on the basis of age, degree of atrophy, character of the residual pubocervical fascia and the presence of factors producing excessive intra-abdominal pressure. Good results are reported in cases in which simple plastic operations have failed, yet the operation is not presented with the idea that it will supplant widely used methods.

With the patient in the lithotomy position, the upper part of the urethra and the neck of the bladder are exposed. The pubocervical fascia is approximated with mattress sutures in a manner that elevates the neck of the bladder behind the symphysis pubis and lengthens the urethra. The plane between the pubocervical fascia and the vagina is followed upward and laterally until the spaces of Retzius on either side of the bladder can be penetrated with the index finger. One end of a Penrose drain 30 cm. in length is placed in the left space of Retzius and the other in the right space of Retzius. The vaginal incision is closed with interrupted sutures; care is taken not to include the underlying tissue or the Penrose drain in the sutures. A self-retaining catheter is put in the bladder. The patient is then put in the dorsal position and a long suprapubic incision is made which curves to the left and extends slightly above the umbilicus to expose the external sheath of the rectus muscle. A fascial strip about 1.5 cm. in width beginning at the upper margin of the wound and extending down to about 2 cm. above the symphysis is mobilized. At this point the peritoneum can be opened and any necessary procedures performed. The ends of the Penrose drain are easily identified. The end of the fascial strip is placed inside the open end of the left arm of the Penrose drain and secured with a suture. Traction on the right arm of the drain carries the strip of fascia around the neck of the bladder and out of the lower angle of the wound, where it is sutured to the margin of the lower sheath of the right rectus muscle. The wound is closed after approximating the rectus muscles. The inlying catheter is taken out on the ninth postoperative day when the sutures are removed. The resumption of normal voiding is delayed in a majority of cases after operation; in 1 case it was delayed for as long as twenty-three days. The symptoms of frequency and urgency, often present for four to six weeks after operation, disappear gradually. Successful results have been obtained in 27 of 30 cases. Failure in 2 cases was probably due to disruption of the reinforced support, with recurrence of the urethrocele. One failure occurred because of a vesical fistula caused by faulty dissection.

Nerve Injury.—Bumpus, Nourse and Thompson [22] report the urologic complications observed in 101 cases of injury or disease of the spinal cord occurring among personnel of the United States Navy.

22. Bumpus, H. C., Jr.; Nourse, M. H., and Thompson, G. J.: Urologic Complications in Injury of the Spinal Cord, J. A. M. A. **133**:366-368 (Feb. 8) 1947.

The most frequent urologic complication of injury of the spinal cord is the so-called cord bladder. In 56 patients this vesical dysfunction followed gunshot or shrapnel wounds. In 34 it resulted from fractures of the spinal column. In 2 it was the result of tumors of the spinal cord and in 5 of inflammatory disease. In 1 case it developed insidiously after the patient had been eighteen months in a Japanese concentration camp and was probably the result of a dietary deficiency. In 1 case it was associated with myelodysplasia and in 1 with a protruding intervertebral disk, and in another it was the aftermath of spinal anesthesia.

The height of the lesion in the cord has a distinct bearing on the urologic complications. Lesions above the conus medullaris, in which physiologists and neurologists place the mechanism of the bladder reflexes and which anatomists place close to the eleventh and twelfth thoracic vertebrae, involve the pathways of inhibitory impulses from the higher centers. Injuries which occur at the conus or below, in the cauda equina, do not interfere with these inhibitory tracts but damage only the reflex arc.

Perhaps of more importance than the level of the lesion is whether it is complete or incomplete. The sparing of nerve tracts and late recovery of the ability to transmit impulses account for unpredictable improvement in many cases.

In the great majority of cases two types of neurogenic vesical dysfunction were demonstrable. There was either an automatic or a reflex type of bladder, in which the lesion was as a rule above the tenth thoracic vertebrae, or a retention bladder with overflow incontinence, in which the injury was usually below the tenth thoracic vertebra and generally involved the cauda equina.

The type of dysfunction produced by lesions low in the spinal column that usually involve the cauda equina is the most responsive to transurethral resection. Examinations through the cystoscope show various degrees of relaxation of the neck of the bladder. In some there is constriction in the region of the internal urethral orifice so that the bladder and the dilated prostatic urethra have an hourglass appearance. In some cases a bar type of deformity is seen and in others an appearance like that of the vocal cords. In all cases the vesical wall is trabeculated.

Treatment in these cases consists of resection of tissue from the entire circumference of the vesical neck; enough is removed to make a definite funnel of the prostatic urethra. Postoperative retention depends then, as after prostatectomy, on the external sphincter. This requires the removal of only a small amount of tissue. If the first resection does not produce the desired effect, multiple operations are indicated, although the total amount of tissue excised seldom exceeds 10 Gm. In 16 cases

of this series multiple resections were employed. Of 39 patients whose injury was at or below the level of the eleventh thoracic vertebra and on whom transurethral resection was performed, 36 now have voluntary urination. They can empty the bladder completely by straining; they sleep through the night without voiding, and they have no incontinence. All these patients can tell when the bladder is full, although the sensation which they feel is not normal. They describe it as a dull ache or a heavy feeling in the lower part of the abdomen.

Transurethral resection has been of much benefit, although not so spectacular, in cases in which lesions are high in the spinal cord and an automatic or reflex bladder has been established which is inefficient in that it does not empty completely. Thus reflex stimulation may occur when the bladder contains 400 cc., and voiding may take place. If, however, 200 cc. of residual urine remains after voiding, the condition must be classed as an inefficient type of automatic bladder. The patient is deprived of the full reservoir function of his bladder. If in some way the bladder can be made to empty completely, the interval of time between reflex urinations can be doubled. In 19 cases transurethral resection has diminished or entirely abolished the amount of residual urine, and in almost all cases in which previously it had been impossible to free the urine of infection, it now has become crystal clear and finally sterile. Such operations have never produced incontinence. On the contrary, they tend to relieve it.

Until such time as the bladder has recovered whatever emptying and retaining function it is going to regain after the initial injury, the question of drainage is paramount. In the first few weeks after injury the use of a urethral catheter, if it can be properly maintained, is the easiest method of caring for vesical drainage. In cases in which drainage will be necessary late into convalescence, suprapubic drainage is preferable. To increase the capacity of the bladder and to try to overcome its spasticity, tidal drainage was used early in convalescence.

A total of 58 patients were treated by transurethral resection. In 57 cases the results of operation were successful, but in 1 case the result was a total failure. Of the 99 patients who are living in the complete group, only 6 are now dependent on catheters; the other 93 can pass their urine without mechanical assistance of any kind. Of this number, 53 have a voluntary type of urination and 40 an automatic type.

Thompson, Nourse and Bumpus [23] found that the complications were many and varied in cases of paraplegia and that the treatment of paraplegic patients requires the close cooperation of the neuro-

23. Thompson, G. J.; Nourse, M. H., and Bumpus, H. C., Jr.: Treatment of Paraplegic: Observations in a Series of One Hundred and One Cases, J. Urol. **57**:1085-1096 (June) 1947.

surgeon, orthopedic surgeon, physical therapist and urologist. Untiring nursing care is of paramount importance. Adequate initial drainage of the bladder is absolutely essential. The fear of catheterization of the neurogenic bladder should be abolished.

The ultimate goal of the urologist in this type of case is to restore a satisfactory function of the bladder and to eliminate infection of the urinary tract. Satisfactory vesical function was established in 93 cases. In 40 of these the function was automatic and in 53 it was voluntary at the time of this report.

Transurethral resection of the vesical neck was performed for 58 patients before satisfactory function of the bladder was obtained. This operation was carried out for 19 of 46 patients who had sustained an injury at the level of the tenth thoracic vertebra or above and for 39 of 55 patients who had lesions at the level of the eleventh thoracic vertebra or below. A total of 79 resections were done for these 58 patients. Forty-seven other genitourinary operations were performed, and 121 operations were carried out on structures outside the urinary tract.

The urine of 85 patients was grossly clear at the time of this report, and repeated cultures of the urine of 39 of these were sterile. Two patients died, neither after surgical treatment. One death was sudden and unexplained; the other occurred in the presence of multiple decubital ulcers three hundred and sixty-nine days after the original injury.

PROSTATE

Surgical Procedures.—Goldstein [24] describes a modification of Young's perineal prostatectomy for use in selected cases. The modification consists of removing the prostatic adenoma extraurethrally and extravesically without opening the urethra except when it is incised for the tractor. Every effort is made toward careful dissection so that the urethra can be preserved. The operation was done in 36 cases. It serves its purpose best in cases in which there is hypertrophy of lateral lobes only or in which only a small degree of hypertrophy is present in the median lobe. The use of a urethral catheter in the bladder without any perineal bags, together with a small pack for the control of oozing of blood, permits primary closure of the wound in more than 60 per cent of the cases. The perineal wound closed in less than seventeen days in more than 77 per cent of the cases.

Little bleeding is encountered in this dissection, which also tends to allow for early closure of the wound. In a large percentage of cases no perineal urinary drainage occurs if the urethral catheter is left in

24. Goldstein, A. E.: Revised Perineal Prostatectomy: Extraurethral and Extravesical Procedure, J. Urol. **57**:1145-1155 (June) 1947.

place for between ten and twelve days. Total urinary incontinence was entirely absent in Goldstein's cases, but in 5 cases partial incontinence was present for from three to forty-five days. The average postoperative stay in the hospital was 22.6 days, but this could be considerably reduced if the patient had sufficient confidence that he could be cared for away from the hospital. The flow of urine returned to normal, without any diurnal or appreciable nocturnal frequency.

The only complication that gave any concern was a rectoperineal fistula, which healed spontaneously. The total mortality rate was considerably reduced when compared with that following other perineal methods. In this series of 36 cases the mortality rate was 2.8 per cent.

Hortolomei [25] draws attention to the added risk of infection dependent on various methods of exploration. This may be avoided by the utilization of intravenous urography. Suprapubic drainage and irrigation of the bladder are also sources of danger. It would seem wiser to follow the rule of no exploration before operation and no drainage and no irrigation after operation. The authors have employed Hey's surgical technic of aseptic prostatectomy in 44 cases. This technic needs rigorous asepsis and perfect hemostasis. Millin in Great Britain and Fabre in France also have used aseptic prostatectomy; Millin employed the suprapubic route without opening the bladder and Fabre the transverse route of approach. The age of the patients treated by Hortolomei and his associates ranged from 50 to 83 years. There was only 1 death, that of an old alcoholic addict suffering from pneumonia and delirium tremens. The indications for operation were based on age, general condition, state of the liver, and condition of the cardiovascular system, lungs and kidneys. Hyperazotemia was not considered as a definite contraindication. With rare exceptions, the postoperative results were excellent. The anticoagulating property of sodium citrate favors perfect vesical drainage, and the urine cleared up in from three to five days. Fever, which occurred in only 7 cases, was mild and lasted for only two or three days.

Sulfonamide compounds and penicillin were used to combat infection. It is too early to judge the late results in these cases, but from their experience the authors conclude that aseptic prostatectomy affords a minimal morbidity, simplifies the postoperative course and care, shortens hospitalization and makes it possible to extend surgical indications.

Millin [26] states that retropubic prostatectomy can be performed in twenty minutes, permits almost perfect hemostasis, causes only mild

25. Hortolomei, N.; Olanesco, G., and Georgesco, C.: Sur la prostatectomie aseptique, J. d'urol. **53**:245-249, 1946-1947.

26. Millin, T.: La prostatectomie retropubienne, in Trente-neuvieme congrès français d'urologie, October 1945, pp. 400-404.

postoperative reaction, removes the whole adenoma and can be performed during spinal or general anesthesia. Endoscopy will reveal the nature of the obstruction and exclude other intravesical disease. After evacuation of the bladder and withdrawal of the cystourethroscope, a suprapubic incision is begun 1 cm. above the pubis and continued 6 to 7 cm. toward the umbilicus through skin, fatty tissue and aponeurosis. After the rectus major muscles and the peritoneum are separated, an automatic retractor is inserted. The veins rising from the deep dorsal vein of the penis are exposed to the puboprostatic plexus, and the median group and the lateral groups are ligated. After exposure of the prostate, a transverse incision is made in the true capsule to within 1 cm. of the vesical neck. After exposure of the entire anterior surface and a portion of the lateral surfaces of the gland, an inverse V incision in the false capsule exposes the adenoma. The latter is enucleated, and bleeding vessels are caught and coagulated. A no. 18 rubber catheter is then passed through the urethra into the prostatic bed and guided through the internal sphincter into the bladder. The prostatic bed is then closed with surgical gut and the incision in the true capsule repaired. After cleaning of the wound and the removal of two tampons in the lateral recesses, sulfonamide powder is insufflated into the cavity of Retzius, and a small rubber drain is inserted. The wound is then closed with bilateral ligatures in the vas deferens. Clots are removed by irrigation, and the bladder is filled with 100 cc. of the solution. The catheter is then closed and fixed to the penis with one or two stitches.

Two hours after the patient has returned to his bed the clamp on the catheter is removed, and within twenty-four hours, or at most three days, the urine is clear. On the second day the drain is removed and the patient is allowed to sit up for ten minutes. On the sixth day the catheter is removed, and on the fourteenth day the patient is dismissed. There were no deaths among the first 20 patients treated although 2 were more than 80 years of age and 3 had coronary thrombosis. Seventeen of the 20 patients left the hospital on the fourteenth day after operation.

Bouchard [27] reports a case of incontinence following retropubic prostatectomy. The patient, aged 52 years, had complete retention; a permanent catheter was left in situ for about seven weeks. The bladder was irrigated, and antiseptics were administered internally for Bacillus coli infection. Shortly thereafter urethroscopic examination revealed a characteristic deformity of the vesical neck, with considerable elongation of the urethra, which was compressed by lateral masses. The patient's general condition was good, and although urethrovesical

27. Bouchard: Un cas d'incontinence apres operation de Millin, in Quarantieme congrès français d'urologie, October 1946, pp. 399-402.

infection due to prolonged catheterization was not considered as an ideal situation, Millin's operation was done. The immediate results of the operation, for which spinal anesthesia was employed, were good in spite of the difficulties due to inflammatory lesions. However, after removal of the catheter, complete incontinence persisted. Urethroscopic examination revealed a deformed vesical neck, with polypoid inflammation of the mucosa. Since the lesions were purely inflammatory, electrocoagulation under epidural anesthesia was attempted. When the catheter was removed three days after the procedure, incontinence had disappeared. Instillations of silver nitrate were given to insure good cicatrization, and when the patient was discharged he had full control of his bladder.

Incontinence is a rare sequel of Millin's operation; Millin himself has seen this result in only 2 cases.

Urethral dilation had no effect on the inflammatory lesions of the vesical neck, which were so severe that even silver nitrate did not affect them. Electrocoagulation led to immediate cure of incontinence.

Transurethral Resection.—In a series of 800 endourethral resections for adenoma of the prostate performed from 1934 to 1945, Denis[28] found the mortality rate to be slightly more than 2 per cent. Under certain conditions resection is a benign type of intervention, but a prime requisite for its success is the appreciation of its difficulty and the need for patience and persistence in its execution. If urination is only partially restored or not restored at all, resection can be repeated. For patients who do not have an artificial outlet from the bladder and who cannot tolerate a permanent catheter indefinitely, the operation must be completed promptly. In cystostomized patients the progress of resection can be controlled by means of a finger introduced into the suprapubic opening. Careful postoperative observation is imperative to detect detached or obstructed catheters and bleeding vessels, which may result in fever and chills and compromise the end result. The author's two way catheter left in situ for twenty-four hours after operation whenever slight hemorrhage is evident yields good results.

Most failures are attributable to the fact that, having easily accomplished transurethral resection of the vesical portion of the prostate, the surgeon considers his task finished, whereas the actual endourethral resection remains to be done. The difficulty of resection depends on the relation of the prostate to the vesical neck rather than on the actual size of the prostate. Fairly large prostates protruding into the bladder can be resected with relative ease whereas perineal prostates protruding into the rectum and perineum offer greater difficulty because

28. Denis, R.: Étude de 925 cas de résection endo-urétrale pour hypertrophie prostatique, J. d'urol. **52**:262-264, 1944-1945.

the surgeon has to work through a funnel-shaped tract instead of through one opening into a cavity. Incomplete resection will lead to recurrence, and too radical resection will lead to incontinence. Total incontinence was observed in no instance in the present series; slight incontinence was observed in 2 cases after exertion and in 1 case when the patient rose suddenly from a sitting position.

As a first experience with resection in unselected cases, the results are considered encouraging. Resection is indicated primarily for patients not yet suitable for prostatectomy, that is, for patients who have dysuria, hypertrophy of the prostate and less than 100 cc. of residual urine. In these cases, resection should be done at once to prevent distention and the development of uremia. For patients in the more advanced stages, constituting nine tenths of the current clientele, resection can be recommended because of its low mortality rate, the suprapubic route being reserved for patients who have residual urine but whose condition otherwise is apparently unsuitable for endourethral resection.

Creevy [29] discusses hemolytic reactions during transurethral prostatic resection. Evidence is presented that water used as irrigating fluid may enter the circulation through open prostatic veins during transurethral resection and may cause hemolysis. This may lead to severe anemia and to hemoglobinemia which may cause toxic changes in the tubular epithelium and plugging of the collecting tubules. Uremia results. These effects are probably aggravated by renal vasoconstriction produced by the rapid loss of blood and by preexisting lesions of the kidneys, such as arteriosclerosis, hydronephrosis and pyelonephritis. The hemoglobinemia also causes jaundice. The reaction is similar to that seen after a transfusion with incompatible blood. A fatal case is reported in which severe hemoglobinemia was followed by uremia and death. Pigmented casts were found in the collecting tubules. There is no satisfactory treatment for severe hemolysis, although peritoneal lavage may prolong life until the kidneys have recovered their function.

Hemolytic reactions can be prevented by the use of a sterile 4 per cent solution of glucose as an irrigating fluid during operation. This often causes a striking increase in the blood sugar, which in some cases may reach as high as 1,000 mg. per hundred cubic centimeters of blood. One disadvantage of using glucose in irrigation is its cost. It also interferes with the resectoscope, it is more difficult to see through and in cases of diabetes there is the problem of controlling the blood sugar. Postoperatively, Creevy uses 0.5 per cent isotonic sodium chloride solution for irrigation of the bladder. The results following the use of a solution of glucose have been good in 158 cases. No hemolytic

29. Creevy, C. D.: Hemolytic Reactions During Transurethral Prostatic Resection, J. Urol. **58**:125-131 (Aug.) 1947.

reactions have occurred, and both morbidity and mortality have been reduced.

McLaughlin, Holyoke and Bowler[30] describe the post-transurethral resection syndrome in 3 patients who died on the fourth, ninth and tenth days after resection respectively. In each case there was excessive bleeding, and a prolonged attempt had been made to obtain hemostasis by electrocoagulation. Emergency cystotomies were performed, and in 2 cases the vesical necks were found to be perforated. The kidneys of 1 patient who came to necropsy contained a few undilated tubules filled with pink-staining hyaline casts and inflammatory cells and those of the other patient showed dilated tubules which contained pigmented casts, inflammatory cells and occasional areas of necrosis.

Oliguria, or even anuria, may be present from the time of the resection but usually begins the second or third day after resection. Subjectively the patient may feel entirely well, but he usually complains of anorexia and nausea. Frequently vomiting and hiccuping occur, and mild jaundice is present. A few patients go on to recovery, but the mortality rate is high. As many as 20 per cent of all deaths after transurethral resection are due to this syndrome.

Explanation of the syndrome is complicated, since it probably results from a combination of factors. The clinical picture is similar to that seen with hemoglobinemia following infusion of incompatible blood. During transurethral surgery, sterile tap or distilled water may enter the circulation by way of open prostatic veins and cause rapid hemolysis. The degree of hemoglobinemia thus produced depends on the amount of water entering the circulation. The mechanism of renal damage in hemoglobinemia is not fully understood. Minute amounts of hemoglobin in the plasma are known to produce vasoconstriction in the kidneys without being precipitated in the tubules. In order to prevent excessive hemoglobinemia, the height of the column of irrigating solution should be kept at the lowest level consistent with efficient handling of the resectoscope. Extreme care must be exercised as the capsule of the prostate is exposed. When bleeding from a venous sinus is encountered, prolonged attempts at hemostasis should be avoided and prompt replacement of blood lost is imperative. Sterile tap or distilled water may yet prove to be the most satisfactory irrigating medium because isotonic solutions now under investigation have one or more disadvantages.

Malignant Neoplasms.—Hinman[31] estimates that 3,000,000 to 5,000,000, and possibly as many as 8,000,000 Americans have cancer of

30. McLaughlin, W. L.; Holyoke, J. B., and Bowler, J. P.: Oliguria Following Transurethral Resection of the Prostate Gland, J. Urol. **58**:47-59 (July) 1947.

31. Hinman, F.: The Obstructive Prostate, J. A. M. A. **135**:136-141 (Sept. 20) 1947.

the prostate. Benign prostatic enlargement develops in 50 per cent of men past 45 years of age. The two conditions commonly occur together, but each is a separate and distinct lesion.

Benign enlargement arises from the periurethral glands and, since it is a new growth of fibrous, muscular and glandular tissue, should be called a "fibromyoadenoma."

Malignant lesions arise from any part of the parenchyma of the true prostate, usually the periphery. The lesions which arise near the posterior portion are palpable early through the rectum. All other lesions, no matter where they start, will in time be palpable, but they will not be diagnosed until late. It is the early cancerous lesion which is most suitable for radical surgical intervention; yet only 5 of every 100 men with cancer of the prostate are seen early enough for this type of operation. Even so, Hinman reports that 56.5 per cent of 25 patients operated on five years or more previously are alive. Experience with castration and endocrine therapy has not covered a period of five years, but it is doubtful if there has been a reduction of deaths since institution of this type of treatment. The immediate benefits of this type of treatment, which are often remarkable, are not permanent, and the cancer may show an increase of virulence after it.

An effort should be made to increase the number of early diagnoses above the present dismal 5 per cent.

Mathé and Ardila[32] review 130 cases of carcinoma of the prostate treated between 1940 and 1946. Operative intervention was employed in 108; transurethral resection was carried out in 77, radical perineal prostatectomy in 3 and suprapubic enucleation in 28. In 11 advanced cases medical care or roentgen therapy only was given. In 2 cystotomy was performed for relief of retention due to obstruction, and in 9 orchiectomy and stilbestrol therapy alone were carried out.

Twenty-eight (8 per cent) of the 337 specimens of prostate removed for benign hypertrophy in which carcinoma was not suspected were carcinomatous.

The mortality rate following operative intervention for carcinoma of the prostate was 11 per cent in the authors' 108 cases, as compared with 3.5 per cent in 337 prostatectomies for benign adenoma during the past five years.

Rectal palpation is still the sole method of early diagnosis. Only 3 lesions in this series were detected early enough to justify radical perineal prostatectomy. Cystoscopy, cystography and roentgenologic examination of the skeletal system and the lungs corroborated the presence of varying stages of cancer with or without metastasis. Elevation of blood acid phosphatase, although of great aid when present, was of no value in cases of elusive disease.

32. Mathé, C. P., and Ardila, C. E.: Carcinoma of the Prostate, Surg., Gynec. & Obst. **84**:276-282 (March) 1947.

In 11 per cent of 77 patients treated by transurethral resection who presented positive clinical evidence of carcinoma, histologic examination of the specimens removed failed to reveal the presence of carcinoma. The favorable subsequent clinical course warrants the contention that transurethral resection, orchiectomy and stilbestrol therapy should be given in such cases.

Radical perineal prostatectomy is the treatment of choice for early carcinoma. Unfortunately, it is of no value in cases of occult cancer and does not provide for removal of regional lymphatic vessels. Transurethral resection, supplemented by stilbestrol therapy, orchiectomy and high voltage irradiation for intractable metastatic pain resulted in definite improvement and increased longevity in 80 per cent of patients.

Although the disease is progressive and fatal, the present palliative measures are justified as they relieve urinary obstruction, ameliorate toxic symptoms and thereby prolong life.

Ormond,[33] in discussing the results of 27 radical operations for early prostatic carcinoma, states that the mortality rate from the operation is extremely low. Injury to the rectum is uncommon and usually heals spontaneously. Incontinence following operation is uncommon. Even when cure is not obtained, the operation does not hasten the incidence of metastasis. Urinary obstruction does not recur even when cure is not obtained. Some cures are obtained by this method, which cannot be claimed for any other method. It would seem, therefore, that the radical operation is a valuable and benign procedure and deserves to be used more widely.

Darget[34] noted striking reactions in the mammary glands in the treatment of carcinoma of the prostate with larger doses of estrogen (10 mg.). Such reactions are common, but they usually subside promptly on reduction of the dosage or on interruption of treatment for a time. A recent case proved that these reactions are not always harmless. After the removal of a malignant prostate, cachexia, generalized pain and bony metastasis developed. Pain and general and local symptoms responded to administration of estrogens, and the patient considered himself cured. However, since the bony metastasis persisted, the hormone treatment was continued. After five months, intolerance to estrogen developed, and cachexia and pain recurred, with pronounced azotemia and insomnia. Locally the prostate showed no change, but two large mammary tumors had developed. They were the size of oranges and hard and movable over the pectoral plane. The tumors were

33. Ormond, J. K.: Radical Perineal Prostatectomy for Carcinoma, J. Urol. **58**:61-67 (July) 1947.

34. Darget, R.: Epithelioma bilateral de la glande mammaire a la suite de l'emploi prolongé d'un oestrogene de synthese dans la traitement d'un cancer prostatique, in Quarantieme congrès français d'urologie, October 1946, pp. 405-413.

removed together with the glands in the right axilla. A bilateral orchiectomy was done. Examination of the specimens removed from the breast revealed bilateral atypical, alveolar epithelioma showing a carcinomatous rather than a scirrhous trend. The axillary glands were likewise invaded by atypical epithelioma.

Lacassagne reported mammary carcinoma following treatment of male mice with stilbestrol. The risk of producing a mammary cancer, which can easily be removed, should be no deterrent to employing hormone therapy for carcinoma of the prostate. In cases in which synthetic estrogen is poorly tolerated or yields poor results, orchiectomy is recommended. According to Perrier, carcinoma of the breast may be coincident with carcinoma of the prostate or metastatic from the latter. However, in Darget's case histologic examination of the specimens yielded no evidence of a metastatic nature of the growths. Interruption of treatment is considered a possible stimulus to the malignant growth.

PENIS

Malignant Neoplasm.—Dargent[35] presents an analysis of 56 cases of malignant lesions of the penis treated at the Anti-Cancer Center at Lyons from 1924 to 1944. Location and etiology are discussed, and the high incidence of spindle cell epithelioma (48 of 56 cases) is emphasized. Hematogenous dissemination is rare and occurred in only 3 cases. Malignant lesions of the frenum are fortunately extremely rare, since they most frequently give rise to glandular involvement. The latter is true also of cancers of the corpora cavernosa. The grade of malignancy seems to be higher in young persons than in the more aged. Survivals of fifteen years are most frequent when the patient is in the seventh decade of life.

Surgical intervention may be tried after failure of radiotherapy or vice versa. Indications for the various types of treatment will be determined by the location of the tumor and type of infiltration. Instances of late radiosarcoma have been reported as late results of irradiation for epithelioma. Also the high incidence of tumors of other viscera in patients living for five years after treatment for malignant lesions of the penis is mentioned. Malignant lesions of the sheath and the preputial mucosa may be treated by circumcision and radiotherapy as for cutaneous cancer. Cancers involving the frenum will require amputation of the penis and removal of the inguinal glands. Lesions in this location are malignant, and early postoperative irradiation of the inguinoiliac region is imperative.

Surgical intervention is indicated for infiltrating tumors, with amputation of the penis and routine extirpation of the inguinal nodes. If

35. Dargent, M.: Positions respectives de la chirurgie et de la radiothérapie dans le traitement du cancer de la verge, J. d'urol. **53**:234-244, 1946-1947.

the lesions are aseptic, this can be accomplished simultaneously, and if not, it can be done secondarily. Postoperatively irradiation of the glandular region is necessary. In early persistent superficial forms of malignant lesions associated with radionecrotic lesions, amputation and removal of the glands will be required. Recurrence in the stump after amputation is serious. If only a partial amputation was done primarily, complete amputation may be done, with removal of the glands. If there has been a radical amputation, irradiation may be tried. In the latter instance, invasion of the iliac nodes presents a poor prognosis.

In cases in which electrosurgical treatment fails, radium or surgical intervention may yield better results if the patients are seen early. Preliminary coagulation usually creates radioresistence. However, if the lesion is small and superficial, radium treatment may suffice. If the corpora cavernosa are infiltrated, amputation and removal of the glands are indicated.

Peyronie's Disease.—Lavenant[36] states that plastic induration of the corpora cavernosa is looked on as a local lesion. Since 1920, he has been able to observe, treat and follow up 55 patients, and after various examinations he has come to certain conclusions which differ markedly from the classic conceptions of the disease. The latter have included theories on arthritic, gouty, diabetic, tuberculous, gonorrheal and syphilitic origin as well as microtraumatism and even atavism.

May obtained positive results from the Frei test in 80 per cent of cases. Often plastic induration has been regarded as being dependent on senility, but the condition has been reported in men of 26 to 37 years of age.

Lavenant states that the various etiologic theories are not to be categorically rejected and that induration of the corpora cavernosa is only a local manifestation of some general disorder, whether it is an infection, an intoxication or a deficiency, which in turn leads to glandular deficiency, with a resulting tendency toward the formation of fibrous tissue. Good but not constant results have been reported from roentgen therapy and ionization. The author states that, according to individual symptoms and deficiencies, these patients may respond to iodine and sulfur therapy as well as to carefully selected endocrine therapy. Among factors observed to play some part in exacerbation of symptoms he mentions dietary deficiencies, cold, alveolar pyorrhea and hypercholesterolemia.

Cartilage Grafts for Impotence.—Solomon and Karleen[37] report the successful implantation of costal cartilage grafts for correction of

36. Lavenant, A.: Pathogenie et evolution de l'induration plastique des corps caverneux, in Quarantieme congrès française d'urologie, October 1946, pp. 442-451.

37. Solomon, A. A., and Karleen, C. I.: Impotence Following Trauma to Corpora Cavernosa Relieved by Cartilage Grafts: A Case Report, J. Urol. **58**: 289-294 (Oct.) 1947.

impotence resulting from trauma to the corpora cavernosa. Two grafts, each about 2½ inches (6.3 cm.) in length, were inserted beneath Buck's fascia on each side of the penis. Sexual efficiency was improved, and there was no pain or discomfort during coitus because of the rigidity of the implanted material.

URETHRA

Malignant Neoplasms.—Lower and Hausfeld[38] discuss primary carcinoma of the male urethra and report 10 cases. They state that the condition is an uncommon clinical entity, and yet every urologist and surgeon should be familiar with it. A review of the literature and of the reported cases indicates that when its clinical manifestations are encountered they are often incorrectly interpreted. Treatment is frequently directed to the stricture or the complication thereof, such as rupture of the urethra with perineal abscess and urinary fistula; hence, when the true condition is discovered, the malignant process has spread beyond its local origin and treatment is no longer effective.

Any progressive difficulty in urination, especially when associated with a periurethral mass, or the onset of rather sudden appreciable difficulty in the dilation of strictures which have been treated by instrumentation for some time should immediately suggest the possibility of malignant disease of the urethra. If the diagnosis is made early, extensive resection of the urethra would seem the treatment of choice. In certain selected cases the condition probably would respond to radiation.

Modern urologic instruments and the newer chemotherapeutic agents greatly facilitate and lessen the danger of removal of a specimen for biopsy, and patients who have malignant disease of the urethra should benefit by the most effective and modern therapeutic measures.

Zaslow and Priestley[39] note that primary carcinoma of the male urethra is a relatively uncommon lesion. In a review of the cases at the Mayo Clinic, they found that 25 instances of primary urethral neoplasm had been encountered from 1910 to 1945 inclusive. The diagnosis was established by microscopic examination in all but 3 cases. In all cases in which histologic study was made the diagnosis was epithelioma.

The classification offered by Kreutzmann and Colloff is practical and useful in discussing urethral carcinoma. These authors considered all growths in the penile urethra as "anterior" and all others as "posterior." From a therapeutic point of view, treatment frequently varies, depending on the location of the lesion. In Zaslow and Priestley's series of cases the growth was situated anteriorly in 10 cases and posteriorly in 14,

38. Lower, W. E., and Hausfeld, K. F.: Primary Carcinoma of the Male Urethra: Report of Ten Cases, J. Urol. **58**:192-206 (Sept.) 1947.

39. Zaslow, J., and Priestley, J. T.: Primary Carcinoma of the Male Urethra, J. Urol. **58**:207-211 (Sept.) 1947.

and in 1 case both the anterior and posterior portions of the urethra were involved; this incidence is in accord with reports in the literature. So far as symptoms and clinical characteristics are concerned, there was little difference regardless of the location of the growth; however, the most common initial symptom of an anterior lesion was difficulty in micturition, whereas hematuria was most often the presenting symptom of a posterior lesion. If a growth is of appreciable size, it can be palpated, especially if it is located in the anterior urethra. Six of the 25 patients presented a history of urethral stricture prior to the onset of symptoms referable to the neoplasm. The average age of the patients was 56 years, and the youngest was only 28 years of age. The grade of malignancy was determined in 20 cases, and in 19 was either 2 or 3.

Treatment varied, depending on the location and extent of the lesion. In the 10 cases in which the growth was located in the penile urethra, amputation, radium and fulguration were employed with equal frequency. Amputation, which may be partial rather than complete, is preferable for the more extensive lesions. It is well to remember, however, that a partial amputation which leaves virtually no urethra which may be grasped during micturition to direct the stream may be more of a handicap to the patient than a perineal urethral meatus which can always be used satisfactorily in the sitting position. For a relatively small growth in the region of the fossa navicularis, radium may be applied directly. Fulguration can be used to destroy a relatively small lesion. If there is any question about the complete destruction of the growth in situ by either of these methods, amputation would seem the treatment of choice.

Treatment of an epithelioma situated in the membranous or prostatic urethra is somewhat more difficult. In the present series of cases, prostatectomy, cauterization, application of radium, transurethral removal and fulguration and roentgen therapy were employed.

The prognosis seems more favorable for lesions in the anterior part of the urethra than for those in the posterior part. Since at least half the patients with anterior urethral lesions are living two years after operation, while half those with posterior urethral lesions are dead one year after operation, probably the difficulty of complete removal of a growth situated posteriorly may be a factor in this regard. Of the 10 patients who had an epithelioma in the anterior part of the urethra, 3 are known to be dead and 7 are living. Three of these 7 have had a recurrence, and none of them is known to have survived for as long as five years. The shortest postoperative follow-up in this group of 7 patients was five months and the longest five years, the average being twenty-one months.

Of the 14 patients who had lesions in the posterior part of the urethra, 12 are known to be dead. The fact that a few patients have

survived as long as five years affords some encouragement. For the most part, treatment of these patients consisted of complete surgical removal or local destruction of the lesion.

The role that urethral stricture plays as an etiologic factor in carcinoma of the urethra is questionable. The incidence of this condition prior to development of the malignant lesion, as reported in the literature, seems to indicate that it might be significant, although the majority of patients who have epithelioma of the urethra probably have no antecedent history of stricture.

Artificial Sphincter.—Foley[40] describes a device for control of incontinence in the male which he calls "an artificial sphincter." It consists of an inflatable pneumatic clamp which compresses and occludes the urethra. The clamp is connected by a distention tube to an inflating device that is carried in the pocket. The pneumatic clamp may be applied to the whole circumference of the penis or preferably to a segment of the urethra which is isolated from adjacent structures by a "cutaneous tunnel operation." This permits maximal effectiveness in occluding the urethra. However, the device is not sufficiently perfected to be offered for general use.

Foley enumerates the contraindications for the artificial sphincter and the cutaneous tunnel operation. He states that the device is indicated in cases of juvenile or adult nocturnal enuresis, in some cases of diurnal enuresis, in cases of postoperative incontinence accompanied with a useful bladder with a capacity of 100 cc. or more and in cases of true incontinence due to disturbed innervation and not accompanied with vesical spasticity to the point at which the bladder can retain less than 100 cc. of urine.

WAR INJURIES TO THE GENITOURINARY TRACT

Culp[41] reports on 160 cases of war injuries to the genitourinary tract. Shell fragments were responsible for most of the trauma. Serious injuries to other systems accompanied many of the wounds and necessitated evacuation of some patients to the United States despite excellent urologic results.

Wounds of the external genitalia without injury to the urinary tract presented essentially the same problems as soft tissue wounds in other parts of the body. Seventy-eight per cent of the 54 patients with injuries of this type returned to duty.

---

40. Foley, F. E. B.: An Artificial Sphincter: A New Device and Operation for Control of Enuresis and Urinary Incontinence, J. Urol. **58**:250-259 (Oct.) 1947.

41. Culp, O. S.: War Wounds of the Genito-Urinary Tract: Early Results Observed in One Hundred and Sixty Patients Treated in the European Theater of Operations, J. Urol. **57**:1117-1128 (June) 1947.

Of 26 patients with urethral injuries, 20 had defects in the anterior segment and 6 had damage to the posterior part. Several types of repairs were employed. Eighty-five per cent of the group urinated normally before discharge to duty or evacuation to the United States because of associated injuries.

The 26 injuries to the bladder included 18 wounds which had been treated by early cystostomy with excellent results; 4 wounds from shell fragments retained in the vesical wall, which were removed in the communication zone without difficulty, and 4 blast injuries for which only rest in bed was required for complete recovery.

Six patients were seen with ureteral wounds. In 5 cases the condition was not recognized until fistulas developed. Partial tears healed over indwelling catheters, but complete division required end to end anastomosis or nephrectomy.

Results obtained in the treatment of 48 renal injuries substantiated the contention that conservative management is the treatment of choice and that nephrectomy should be reserved for massive damage, severe hemorrhage or overwhelming infection.

UROGRAPHY

Wilhelm[42] describes his method of making laminagrams by synchronously moving the film and the tube carrier in opposite directions while the exposure is being made. More than seventy perirenal insufflations have been done without fatality or serious sequelae. The laminagrams, as compared with simple roentgenograms, were far superior in delineating the normal adrenal gland and its lesser enlargements. This technic obviated the necessity of bilateral surgical exposure in patients undergoing adrenalectomy.

ANURIA FOLLOWING TRANSFUSION

Berry[43] studied 2 cases in which anuria followed blood transfusions. One kidney of each patient was decapsulated; 1 patient recovered, and the other died. Rh sensitivity was a proved factor in 1 case and a probable factor in the other. Determination of this factor should be done before transfusion in all women, especially those who have borne children. Sodium bicarbonate is of value in treating post-transfusion anuria and should be considered as possibly worth while in all transfusions. Intake of fluid should be limited instead of forced to prevent cerebral and pulmonary edema. Decapsulation can be made a simple

42. Wilhelm, S. F.: Roentgenographic Delineation of the Adrenal Glands With the Aid of Laminography, Brit. J. Urol. **19**:85-89 (June) 1947.

43. Berry, N. E.: Anuria Following Blood Transfusion: Report of Two Cases, J. Urol. **58**:239-241 (Oct.) 1947.

procedure and should be considered if anuria has persisted for seven days in spite of good medical management.

STREPTOMYCIN THERAPY

Pulaski and Amspacher[44] report the critical analysis and study of 465 cases of infection of the urinary tract in which patients were treated with streptomycin. Thirty-four per cent of the patients were cured; an additional 21 per cent were improved, and the remaining 45 per cent were not benefited. Seventy-nine per cent of bacteria isolated were gram-negative bacilli, and 21 per cent were gram-positive cocci. A third of the cocci were nonhemolytic streptococci. Streptomycin had a potent action in vitro on 87 per cent of the bacterial flora encountered. Streptomycin administered parenterally is excreted in high concentrations in the urine, and intramuscular injection is the preferred route. Best results are obtained when infections are due to Escherichia coli and Aerobacter aerogenes. Failures are especially frequent when the causal organism is Pseudomonas aeruginosa. There is no appreciable difference in results of therapy in monobacterial and polybacterial infections, provided, of course, that all organisms are susceptible in vitro to streptomycin. The presence of obstructive calculi precludes a successful chemotherapeutic result. Patients with paraplegia are benefited by streptomycin therapy, although the effects are rarely permanent except in patients with closed urinary systems and automatic bladders. Advanced renal disease, undrained abscesses, the presence of neoplasms and infections in the prostate are causes of failure of streptomycin therapy.

A total dosage of 1 to 2 Gm. of streptomycin per day for three to five days is recommended for treatment of the average infection of the urinary tract due to susceptible organisms. No advantage accrues from the administration of a second course of the drug if the first course has failed to sterilize the urine. Drug fastness is a constant feature in cases in which the prescribed course of treatment has not sterilized the urine. When bacteria are not inhibited in vitro by a concentration of 16 micrograms of streptomycin per cubic centimeter, the chances of eliminating them by the use of streptomycin are not good. This suggests that streptomycin acts primarily through the tissues and not through the urine. Local instillations of streptomycin have proved to be of no value in the authors' experience. Alkalinization of the urine with streptomycin therapy may be advantageous in selected cases. There is no contraindication to the concurrent use of penicillin or sulfonamide compounds with streptomycin if the clinical and laboratory findings warrant it. The percentage of satisfactory results is highest when the requirements

44. Pulaski, E. J., and Amspacher, W. H.: Streptomycin Therapy in Urinary Tract Infections, Surg., Gynec. & Obst. **85**:107-112 (July) 1947.

of (1) free flow of urine, (2) susceptible organisms and (3) adequate dosage of the drug are met and adequate consideration is given to the management of the patient as a whole.

Redewill[45] reports 2 cases of urinary vesical tuberculosis treated with streptomycin. Streptomycin in doses of 800,000 and 1,000,000 units respectively was given daily. Cystitis and ulceration cleared up in 1 case in six weeks and in eight weeks in the other case, in the latter case incipient tuberculosis of the right kidney and involvement of left seminal vesicle and epididymis were present; all apparently cleared up under streptomycin treatment.

Supportive treatment for the whole body is necessary in the treatment of patients with tuberculosis of the genitourinary tract. General treatment with a quartz light is an important adjunct.

CALCIFICATION OF THE VAS DEFERENS AND SEMINAL VESICLES

Shea and Schwartz[46] report extensive bilateral calcification of the seminal vesicles in a patient 38 years of age. Rectal examination revealed both seminal vesicles to be enlarged and stony hard. The prostate was normal in size and somewhat irregular, with areas of induration. A roentgenogram of the pelvis showed two oval-shaped densely calcified shadows near the base of the prostate. Intravenous and retrograde pyelograms revealed a nonfunctioning right kidney. A large tuberculous pyonephrotic kidney was removed. Calcification of the seminal vesicles, ampullae and vasa deferentia is considered a rare condition, and few cases have been reported.

O'Conor and Crowley[47] report a case of bilateral calcification of the vasa deferentia. The patient, aged 73 years, had refractory aplastic anemia, diabetes mellitus, spinal arthritis, advanced arteriosclerosis and benign prostatic hyperplasia. The vasa were so markedly thickened and so calcified that it was impossible to sever them with a scalpel. Sections prepared after decalcification showed a thick muscular wall with masses of calcium and formed bone. Calcification of the vasa deferentia, ampullae and seminal vesicles is rarely encountered either clinically or at necropsy. Only 41 cases have been reported, although the incidence of this condition is probably more common than is indicated by a review of the literature. Calcification of the vas deferens is apparently a senile process accompanying the atrophic and sclerotic changes of old age. It not uncommonly occurs in association with diabetes mellitus.

---

45. Redewill, F. H.: Streptomycin in the Successful Treatment of Tuberculosis of the Urinary Bladder: Report of Two Cases, J. Urol. **58**:35-46 (July) 1947.

46. Shea, J. D., and Schwartz, J. W.: Calcification of the Seminal Vesicles: Case Report, J. Urol. **58**:132-133 (Aug.) 1947.

47. O'Conor, V. J., and Crowley, E.: Bilateral Calcification of the Vasa Deferentia, Quart. Bull., Northwestern Univ. M. School **21**:28-30, 1947.

Tuberculous calcification is usually found in young adults. Any chronic inflammatory condition may be an etiologic factor.

INFECTIONS OF THE URINARY TRACT

Pool and Cook[48] state that two important factors must be considered in the management of infections of the urinary tract. The first is the coexistence of other pathologic processes in the urinary tract. It was observed early that the presence of obstruction, tumor, stone or pronounced chronic inflammatory changes in the urinary tract definitely reduced the efficacy of the ketogenic diet in the eradication of urinary infection and that when none of these pathologic processes was present the results of treatment with the ketogenic diet were much better. Exactly the same observations were made when mandelic acid, the sulfonamide compounds, penicillin and streptomycin were used. The other factor is the variation in the results obtained against various strains of organisms. This definitely suggests the importance of using various therapeutic compounds in alternate courses if one or another fails to eradicate the infection. Of course it is useless to do this if coexisting pathologic conditions have not been remedied first of all.

For the routine treatment of infections of the urinary tract, mandelic acid and the sulfonamide compounds are still the drugs of choice. Penicillin is a great adjunct to treatment, but it has not been the boon for which we had hoped in the ordinary case of nonspecific infection of the urinary tract. Streptomycin therapy produces spectacular results in some cases of resistant urinary infection but cannot be used routinely at the present time. Our studies concerning this drug are incomplete because the supply has been so limited that it has been impossible to carry out the investigative work that should go along with the study of any antiseptic.

ANESTHESIA

Mathé and Ramirez Jaime[49] report the intravenous use of "pentothal sodium" anesthesia for 155 patients on whom 96 major operations and 59 operations of short duration were carried out on the genitourinary organs. There were no deaths or accidents.

"Pentothal sodium" is the anesthetic of choice for cardiac patients for whom the risk is great as well as for the patient who has arteriosclerosis and hypertension. It is contraindicated for children, for patients whose veins are difficult to engage, for patients suffering from hypo-

48. Pool, T. L., and Cook, E. N.: Present Concepts of Treatment of Infections of the Urinary Tract, J. A. M. A. **133**:584-586 (March 1) 1947.

49. Mathé, C. P., and Ramirez Jaime, M. H.: Pentothal Sodium Intravenous Anesthesia in Major Surgical Interventions on the Genito-Urinary Organs: Its Particular Value in the Poor Operative Risk Patient, J. Urol. **58**:163-170 (Sept.) 1947.

tension, shock and extensive hepatic and renal damage, for those who have obstructive diseases of the upper part of the respiratory tract and for those receiving sulfonamide therapy.

Its use is followed by few complications, such as nausea, vomiting, gaseous distention, ileus, atelectasis, pneumothorax and pneumonia. Renal secretion is unaffected during its administration, and anuria does not ensue.

It is safe when administered by the skilled anesthetist and when used on carefully selected patients. Recorded fatalities were due to improper selection of patients, faulty technic which consists of too rapid administration of the drug, too high dosage and failure to supplement with oxygen to counteract depression of the respiratory center.

The authors state that "pentothal sodium" anesthesia far surpasses general and spinal anesthesia and makes it possible to operate on many patients who could not otherwise undergo operation.

INDEX TO VOLUME 57

Abel, S.: Endometriosis in general abdominal surgery, 286
Abdomen: See also Gastrointestinal Tract; Pelvis; etc.
anatomic study of vagus nerves, 333
and thorax, actinomycosis of, 202
endometriosis in general abdominal surgery, 286
inguinal and femoral hernioplasty; anatomic repair, 524
injuries; hemorrhagic cyst of mesentery of ileum, 301
pain; early diagnosis and roentgen manifestations of obstruction of small bowel, 460
pressure in; prevention and treatment of wound dehiscence, 217
role of antibiotics in masking inflammatory processes, 513
subphrenic abscess, 843
tantalum gauze in repair of large postoperative ventral hernias, 234
Abnormalities and Deformities: See under names of diseases, organs and regions, as Aorta; Bladder; Breast; Esophagus; Foot; Genitals; Kidneys; Ureters; etc.
Abscess: See also under names of organs and regions, as Meninges; etc.
Perinephric: See Perinephritis
subphrenic, 843
Accidents: See Aviation and Aviators; Trauma; etc.
Acetabulum: See Hip
Achlorhydria: See Stomach, acidity
Achs, S.: Mixed tumor of bridge of nose, 148
Acid, Amino: See Amino Acids
Hydrochloric: See Stomach, acidity
Acidosis; special solutions for severe alkalosis and acidosis, 578
in acute and chronic nephritis, 571
Acromioclavicular Joint: See Shoulder
Actinomycosis of thorax and abdomen, 202
Adenoma of prostate, endourethral resections for, 918
treatment of thyroiditis, 443
Adipose Tissue: See Fat; Lipoma
Adrenals, tumors of, 708
Aeronautics: See Aviation and Aviators
Agglutinins and Agglutination, use against pleuropneumonia-like organisms, 732
Air Force: See Aviation and Aviators
Alcohol; chemical nature of osteogenic substance extracted from bone tissue with alcohol, 866
Alkalosis; special solutions for severe alkalosis and acidosis, 578
Allergy: See Anaphylaxis and Allergy
Altemeier, W. A.: Reevaluation of penicillin dosage schedules, 396
American Academy of Orthopaedic Surgeons; progress in orthopedic surgery for 1946; review prepared by Editorial Board, 729, 855
Amino Acids: See also Nitrogen; Proteins
effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
intravenously administered; effect on stomach of woman with gastric fistula, 10
parenteral feeding of protein, 185
Ampulla of Vater: See Vater's Ampulla
Amputation, transmetatarsal, value in management of gangrene of toes, 497
Analgesia: See Anesthesia
Anaphylaxis and Allergy; relation of allergy to arthritis, 734
Anastomosis: See Colon; Intestines; Rectum; Sigmoid; Trachea; etc.
Anderson, M. E.: Conditions involving knee joint, 743
Androgens; testosterone propionate in treatment of recurrent cancer of breast, 385
Anemia; leiomyosarcoma of stomach; review of 16 cases and report of case of multiple leiomyosarcomas of stomach, 62
Anesthesia, cyclopropane, mindlessness and generalized spastic paralysis following; sequelae in child with acute appendicitis, 405
"pentothal sodium," intravenous use of, 931
Anesthetics: See Anesthesia
Aneurysm, renal arteriovenous, 903
Angioma; classification of vascular neoplasms of bone, 881
Angioneuromyoma, glomus tumors, 895
glomus tumors; summary of 15 cases, 531
Anhydremia: See Dehydration
Ankle: See also Astragalus; Foot; Tarsus; etc.
and foot, conditions involving, 752
miscellaneous fractures and bone transplantation repair, 860
Ankylosis: See Hip; Joints; Knee; Spine; etc.
Anomalies: See under names of diseases, organs and regions, as Aorta; Bladder; Genitals; Kidneys; Ureters; Vas Deferens
Anoxemia: See Oxygen, deficiency
Anoxia: See Oxygen, deficiency
Antibiotics: See also Penicillin; Streptomycin; etc.
role in masking inflammatory processes, 513
Antisepsis and Antiseptics: See also Urinary Tract
preoperative place of streptomycin in operations on bowel, 520
Antitoxin: See Tetanus
Anuria: See Urine, suppression
Anus: See also Rectum
and rectum, anastomosis of ileum to lower part; report on experiences with ileorectostomy and ileoproctostomy, with special reference to polyposis, 276
artificial; experiences with the Dragstedt skin-covered ileostomy, 487
artificial; ileostomy drainage and diarrhea, 570
surgical anatomy of anal canal, 971
Anxiety state with tremor of ipsilateral lower extremity, 751
Aorta, abnormalities, double arch; report of 2 cases, 227
Apparatus: See also Fractures; Instruments; Orthopedics; etc.
orthopedic, in convalescent care of meniscectomy patients, 661
Appendicitis: See also Appendix
endometriosis in general abdominal surgery, 286
mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Appendix, Abscess: See Appendicitis
actinomycosis of thorax and abdomen, 202
Aqueduct of Sylvius: See under Brain
Armed Forces Personnel: See Aviation and Aviators; Military Medicine; Naval Medicine; etc.
Armies: See Military Medicine

Arms: See also Extremities; Forearm; Humerus; etc.
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
Army Air Forces: See Aviation and Aviators
Arteries: See also Aneurysm; Aorta; Arteriosclerosis; Blood pressure; Blood vessels; Embolism; Thrombosis; etc.
aortic embolism, 613
blood supply of common bile duct, 599
Arteriosclerosis, value of transmetatarsal amputations in management of gangrene of toes, 497
Arthritis: See also Gout; Osteoarthritis; Reiter's Disease; and under names of joints
and sterol metabolism, 737
arthralgias due to nervous causes, 734
as social and industrial problem, 742
blood sugar content in arthritic patients, 734
chronic, 729
chronic, histamine injections in, 739
chronic, vitamins in treatment of, 738
chrysotherapy in, 737
degenerative arthritic knee, 659
hypertrophic, of knee joint, 751
menopausal, 731
physical therapy in, 740
rheumatoid, in childhood, 730
rheumatoid; nature of Still's disease, 730
rheumatoid, sedimentation rate in, 735
roentgen therapy in, 740
serologic studies in experimentally produced polyarthritis, 732
therapy, use of streptomycin as antibiotic in, 735
Arthrodesis: See Foot, deformities; Hip; Joints; Knee; Scaphoid Bone, Carpal; Wrist; etc.
Arthrosis: See under Knee
Ascites; chemical studies on experimental hepatic congestion in dog, 24
Asepsis: See Antisepsis and Antiseptics
Astragalus; arthrodesis of tarsal bones; study of failure of fusions, 162
Atherosclerosis: See Arteriosclerosis
Atrophy: See under names of organs and regions, as Bones, atrophy; etc.
Aviation and Aviators; orthopedic surgery in Army Air [illegible]s during World War II; introduction [illegible]d internal derangements of knee, 64
orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
Avitaminosis: See under Vitamins
Azotemia: See under Blood

Bacilli: See Bacteria
Bacteria, Actinobacilli: See Actinomycosis
reevaluation of penicillin dosage schedules, 396
Ballantine, H. T.: Carcinoma of lung with intracranial metastasis; successful removal of metastatic and primary lesions, 849
Bankart Operation: See Shoulder
Bateman, J. G.: Conditions involving knee joint, 743
Battle Casualties: See Wounds
Bauer, T. B.: Keloids and hypertrophic scars, 539
Beck, N. R.: Tumors of bone and of synovial membrane, 871
Behrend, A.: Chronic pancreatitis causing complete and incomplete obstruction of common bile duct, 51
Behrend, M.: Chronic pancreatitis causing complete and incomplete obstruction of common bile duct, 51
Berry, R. E. L.: Potassium metabolism in immediate postoperative period, 470
Best, R. R.: Anastomosis of ileum to lower part of rectum and anus; report on experiences with ileorectostomy and ileoproctostomy, with special reference to polyposis, 276
Bile Ducts: See also Biliary Tract
common, arterial blood supply of, 599
common, chronic pancreatitis causing complete and incomplete obstruction of, 51
extrahepatic, complete stricture of; external hepaticostomy followed by spontaneous hepatoduodenal fistula, 18
Fistula: See Fistula
Biliary Tract: See also Bile Ducts; Liver
arterial blood supply of common bile duct, 599
Fistula: See Fistula
surgical problem of periampullary cancer, 71
Biopsies; diagnosis of bone tumors by aspiration, 887
Bladder: See also Urinary Tract
acute exudative cystitis, 908
analine dye cystitis, 714
automatic or reflex type of, 913
calculi, 713
calculi, among paraplegic patients, 908
cord bladder, 913
diverticulum, 713
irradiation reactions after roentgen and radium treatment of female pelvic disease, 908
neoplasms, 711, 906
rupture, 713
transurethral resection, 914
total cystectomy for carcinoma of, 711
urinary, intraperitoneal rupture complicating fracture of pelvis; technics of repair, 681
Blood: See also Anemia; etc.
chemical studies on experimental hepatic congestion in dog, 24
chemical studies on patients with dehydration, 562
Circulation: See also Arteries; Capillaries; etc.
circulation, peripheral, in arthritis, 735
circulation, sympathetic dystrophy, 373
determination and estimation of loss during surgical operations, 435
phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
pressure, high; esophageal varices; 2 cases with different surgical approach, 391
pressure, high; hypertension and renal disease, 707
pressure, high; hypertension in cases of unilateral surgical disease of kidney, 903
pressure, high; chemical studies on experimental hepatic congestion in dog, 24
sedimentation rate in rheumatoid arthritis, 735
sugar in arthritic patients, 734
transfusion after burns, 572
transfusion, anuria following, 928
transfusion, parenteral feeding of protein, 185
Vessels: See also Arteries; Capillaries; etc.
vessels; arterial blood supply of common bile duct, 599
vessels; glomus tumors; summary of 15 cases, 531
Body Fluids: See Fluids
Booher, R. J.: Surgical problem of periampullary cancer, 71
Bones: See also under names of bones
and cartilage regeneration, histologic phases of, 864
and synovial membrane, tumors of, 871
atrophy; sympathetic dystrophy, 373
cancellous, viability of, 860
classification of vascular neoplasms, 881
cysts, simple, 871
cysts, solitary (unicameral), 137

Bones—Continued
cysts, treatment of, 874
Diseases: See also Osteochondritis; etc.
diseases; fibrous dysplasia of maxilla and mandible, 872
Dystrophy: See Bones, atrophy; Bones, growth
eosinophilic granuloma of, 890
Ewing sarcoma, 879
Fractures: See Fractures
Graft: See Bones, transplantation
growth and repair, few histochemical considerations relative to, 862
growth, vitamin A deficiency and excess in relation to, 862
iliac, use in grafting and arthrodesis, 859
marrow; chemical nature of osteogenic substance extracted from bone tissue with alcohol, 866
metastatic lesions of, 887
multiple neurofibromatosis and skeletal changes, 892
neoplasms, diagnosis of, 884
operative procedure on fractures and on bony defects, 866
orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
osteogenic sarcoma, 881
osteoid osteoma, 872
phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
sarcoma, treated by radiotherapy, 884
skeletal changes in juvenile arthritis, 730
survival of cortical bone after grafting, 860
transplantation, bone cyst in os calcis treated by bone grafting, 871
transplantation; care of war casualties with defects in long bones, 859
transplantation for fractures of long bones, 857
transplantation for nonunion of femoral neck, 856
transplantation, in relation to nonunion of long bones, spine fusion and arthrodesis of peripheral joints, 858
transplantation in treatment of ununited scaphoid fracture, 814
transplantation; old fracture of mandible, 867
tumors; diagnosis by aspiration, 887
tumors; treatment of multiple myeloma with 4,4'-diamidinostilbene ("stilbamidine"), 885
tumors, vascular, of bone, 879
Borborygmus: See under Intestines
Bradford, B., Jr.: Actinomycosis of thorax and abdomen, 202
Brain: See also Meninges; Nervous System; etc.
carcinoma of lung with intracranial metastasis; successful removal of metastatic and primary lesions, 849
mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Branchial Apparatus; surgical management of branchiogenic cysts and sinus tracts, 450
Bravo, L.: Tumors of bone and of synovial membrane, 871
Breast, lymphatic spread of carcinoma of, 479
persistent gynecomastia in boys, 728
reactions in mammary glands in treatment of carcinoma of prostate with estrogen, 922
testosterone propionate in treatment of recurrent cancer of, 385
Bright's Disease: See Nephritis
Buffers; present day treatment of postoperative duodenal fistula, 637
Burns, 5. See also Cicatrix
fluid and nutritional therapy of, 573
keloids and hypertrophic scars, 539
Bursa, chondromatosis of, 896
Bursitis: See Bursa
Byron, F. X.: Carcinoma of lung with intracranial metastasis; successful removal of metastatic and primary lesions, 849

Calcaneum, cysts, 762
cysts in os calcis treated by bone grafting, 871
Calcification: See Bones, growth; Seminal Vesicles; Vas Deferens; etc.
Calcium and Calcium Compounds; calcium and phosphorus in urine in patients confined to bed with casts, 865
Calculi: See Bladder; Kidneys; etc.
Cameron, B. M.: Conditions involving knee joint, 743
Campbell, D. A.: Actinomycosis of thorax and abdomen, 202
Campbell, K. N.: Potassium metabolism in immediate postoperative period, 470
Camptodactyly: See Fingers and Toes, deformities
Cancer: See also Sarcoma; Tumors; and under names of organs and regions, as Arms; Bladder; Bones; Breast; Colon; Fingers and Toes; Foot; Hand; Kidneys; Legs; Lungs; Pancreas; Penis; Prostate; Rectum; Shoulder; Sigmoid; Stomach; Urethra; Vater's Ampulla; etc.
Metastasis: See also under Brain
metastasis to bone, 887
Capillaries: See also Blood vessels
glomus tumors; summary of 15 cases, 531
Capitulum: See Humerus
Carbuncle, Renal: See Nephritis
Carcinoma: See Cancer
Cardia: See Stomach, cancer
Cardiovascular System: See Arteries; Blood vessels; etc.
Carpal Scaphoid: See Scaphoid Bone, Carpal
Carpus: See Wrist
Cartilage: See also Chondroma; Epiphyses; Osteochondritis; Ribs; etc.
and bone regeneration, histologic phases of, 864
articular, chondromalacia as manifestation of degeneration in, 672
grafts, impotence following trauma to corpora cavernosa relieved by, 924
patellar, lesions as cause of internal derangements of knee, 589
Casts; calcium and phosphorus in urine in patients confined to bed with casts, 865
Catgut: See Sutures
Catheterization: See Ureters
Cauda Equina: See Spinal Cord
Causalgia: See Neuralgia
Cells: See also Tissue
benign giant cell tumor, 874
treatment of bone cysts, 874
Cellulose gauze, oxidized, 727
Cerebrum: See Brain
Chapman, J. P.: Tumors of bone and of synovial membrane, 871
Chemosurgery: See Extremities, cancer
Chemotherapy: See under names of diseases and chemotherapeutic agents, as Actinomycosis; Antibiotics; Intestines, obstruction; Penicillin; Sulfonamides; Wounds; etc.
Chest: See Thorax
Children: See also Infants
flat feet in, 756
pseudoarthrosis in, 857
renal tumors in, 898
skeletal changes in juvenile arthritis, 730
Chin: See Jaws

5-Chloro-Ortho-Toluidine: See Poisons and Poisoning
Cholesterol; chemical studies on experimental hepatic congestion in dog, 24
Chondritis: See under Knee
Chondrogenesis: See under Cartilage
Chondroma, multiple, 878
of bursa, 896
of lower end of femur, 878
of rib, 879
Chondromalacia: See under Knee; Patella; etc.
Chondromyxosarcoma of right thigh, 878
Chondro-Osteo-Dystrophy: See Bones, atrophy
Chondrosarcoma of first metatarsal bone, 877
Chondrosis: See under Knee
Christian-Schüller Syndrome: See Schüller-Christian Syndrome
Chrysotherapy: See under Arthritis
Cicatrix; keloids and hypertrophic scars, 539
vomiting from pyloric obstruction, 569
Circulation: See Blood, circulation
Citrates: See Blood transfusion
Clagett, O. T.: Resection of trachea; experimental study and report of case, 253
Cold: See Temperature
Coley, B. L.: Solitary (unicameral) bone cyst, 137
Colic, Abdominal: See Abdomen, pain
Colitis, ulcerative; experiences with Dragstedt skin-covered ileostomy, 487
Colon: See also Gastrointestinal Tract; Intestines; Sigmoid
anastomosis of ileum to lower part of rectum and anus; report on experiences with ileorectostomy and ileoproctostomy, with reference to polyposis, 276
evaluation of conservative resection with end to end anastomosis for carcinoma of rectum and lower sigmoid colon, 361
Inflammation: See Colitis
Obstruction: See Intestines, obstruction
polypi; experiences with Dragstedt skin-covered ileostomy, 487
preoperative place of streptomycin in operations on bowel, 520
Colostomy: See Anus, artificial
Comedo Carcinoma: See Breast, cancer
Condon, J. B.: Hemorrhagic cyst of mesentery of ileum, 301
Convalescence, care in treatment of dislocations, 809
care of meniscectomy patients, 661
Convulsions; mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Cook, E. N.: Review of urologic surgery, 699, 897
Coracoclavicular Joint: See Shoulder
Corpora Cavernosa: See Penis
Costal Cartilages: See Ribs
Cough; double aortic arch; report of 2 cases, 227
Coxitis: See Hip
Craniotomy: See Cranium, surgery
Cranium, surgery; carcinoma of lung with intracranial metastasis; successful removal of metastasis and primary lesions, 849
Crider, R. J.: Effect of intravenously administered amino acids on stomach of woman with gastric fistula, 10
Physiologic studies on stomach of woman with gastric fistula, 1
Crile, G., Jr.: Treatment of thyroiditis, 443
Crowley, E.: Review of urologic surgery, 699, 897
Crush Syndrome: See Extremities, injuries; Trauma
Cuneiform Bone: See Foot
Curreri, A. R.: Role of antibiotics in masking inflammatory processes, 513
Cutter, W. W.: Arterial blood supply of common bile duct, 599
Cyclopropane: See Anesthesia
Cystectomy: See under Bladder
Cystitis: See under Bladder
Cysts: See under names of organs and regions, as Bones; Branchial Apparatus; Calcaneum; Intestines; Jaws; Kidneys; Lungs; Semilunar Cartilages; etc.
Dermoid: See Tumors, dermoid

Dactylitis: See Fingers and Toes
Davis, H. H.: Esophageal varices; 2 cases with different surgical approach, 391
Deformities: See under names of organs and regions
Degenshein, G.: Patella cubiti; new method for its avulsion, 675
Dehiscence: See under Wounds
Dehydration; acidosis in acute and chronic nephritis, 571
amount of fluid needed for correction of, 573
and electrolytes, 561
chemical studies on patients with, 562
common solutions used for correction of, 576
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
severe, renal insufficiency during and following, 580
symptoms and signs of, 567
Denman, F. R.: Fat embolism; diagnostic enigma, 325
Deossification: See Extremities
Dermoid Cyst: See under Tumors
Dextrose: See also Blood sugar
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
Diabetes Mellitus: See also Blood sugar
ketosis of diabetic and nondiabetic origin, 571
value of transmetatarsal amputations in management of gangrene of toes, 497
Diarrhea and ileostomy drainage, 570
preoperative place of streptomycin in operations on bowel, 520
Diet and Dietetics: See Nutrition; Vitamins
Diethylstilbestrol: See Estrogens
Digestive System: See Gastrointestinal Tract; Intestines; Pancreas; Stomach; etc.
Dislocation: See Shoulder
Diverticulum: See Bladder, diverticulum; Colon; etc.
Douglass, T. C.: Arterial blood supply of common bile duct, 599
D-Tubocurarine: See Spasm
Dunphy, J. E.: Surgical anatomy of anal canal, 791
Duodenal Papilla: See Vater's Ampulla
Duodenum; effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
Fistula: See Fistula
surgical problem of periampullary cancer, 71
Ulcer: See Peptic Ulcer
vomiting from duodenal, jejunal or upper ileal obstruction, 570
Dysostosis: See Bones, growth
Dysplasia: See Bones, diseases
Dystrophy: See also Bones, atrophy
sympathetic, 373

Ejaculatory Ducts: See Seminal Vesicles
Elbow, patella cubiti; new method of treatment for its avulsion, 675
Electrolytes and dehydration, 561
and water in surgical patients, 568
common solutions used to correct dehydration, 576

Electrolytes—Continued
daily replacement of gastrointestinal fluid loss, 581
daily requirements, 561
fluid and nutritional therapy of burns, 573
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
potassium metabolism in immediate postoperative period, 470
Elman, R.: Parenteral feeding of protein, 185
Embolism: See also Thrombosis
aortic, 613
fat; diagnostic enigma, 325
Embryology: See also Teratoma
surgical management of branchiogenic cysts and sinus tracts, 450
Embryoma of kidneys, 897
Emotions; arthralgias due to nervous causes, 734
effect of intravenously administered amino acids on stomach of woman with gastric fistula, 10
knee joint as focus of psychogenic symptoms, 651
physiologic studies on stomach of woman with gastric fistula, 1
sympathetic dystrophy, 373
Empyema: See also Meninges, abscess; etc.
cystic disease of lung, 427
role of antibiotics in masking inflammatory processes, 513
ureteral, 711
Endometriosis in general abdominal surgery, 286
Endothelioma; hemangio-endothelioma, 879
Enuresis: See Urination, incontinence
Eosinophils; eosinophilic granuloma of bone, 890
Epidermis: See Skin
Epidermoid: See Nervous System
Epiphyses; osteotomy for slipped epiphysis, 865
supernumerary phalangeal, 753
Epispadias and hypospadias, 728
Erythrocytes: See Anemia; Hemolysis; etc.
Sedimentation: See Blood, sedimentation
Esophagus; double aortic arch; report of 2 cases, 227
varix; 2 cases with different surgical approach, 391
Estradiol Benzoate: See Estrogens
Estrogens, reactions in mammary glands in treatment of carcinoma of prostate with, 922
therapy in cancer of prostate, 723
Ether: See Anesthesia
Ethyl Alcohol: See Alcohol
Ethylstilbestrol: See Estrogens
Evans, B. H.: Surgical removal of unsuspected mediastinal lymphoblastomas; report of 4 cases and review of literature, 307
Ewing Sarcoma: See Sarcoma
Extremities: See also Arms; Legs; and under names of bones
Blood Supply: See Arteriosclerosis; Blood vessels; Embolism; Thrombosis; etc.
cancer; chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
deossification regional to joints of, 870
disability evaluation of injured extremity, 870
lipoma of, 893
lower, myxoma of, 896
principles of evaluation of disability as applied to injuries of, 870
sympathetic dystrophy, 373

Face; trigeminal tractotomy; observations on 48 cases, 171
Fat, Embolism: See under Embolism
emulsions for parenteral nutrition, 584
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
Feinberg, W. G.: Chemical studies on experimental hepatic congestion in dog, 24
Femur: See also Hip
and patella, trauma to articular surfaces of, 666
bone graft for nonunion of femoral neck, 856
care of war casualties with defects in long bones, 859
chondroma of lower end of, 878
chondromalacia of, 659
Epiphyses: See Epiphyses
fractures and bone transplantation repair, 860
fracture, ununited, of femoral neck, 855
osteochondritis dissecans of femoral condyles and patella, 665
Pellegrini-Stieda disease, 749
reconstruction of hip when loss of head and neck of femur has occurred, 857
solitary (unicameral) bone cyst, 137
surgery; technic of osteotomy for nonunion, 855
Fibromyoadenoma of periurethral glands, 921
Fibrositis: See Rheumatism
Fingers and Toes: See also Foot; Hand; etc.
abnormalities; camptodactyly, 633
changes in sesamoid bones, 753
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
diseases; Heberden's nodes, 732
hallux rigidus, 757
supernumerary phalangeal epiphyses, 753
value of transmetatarsal amputations in management of gangrene of toes, 497
viability of cancellous bone, 860
Fistula; bile or pancreatic fistula drainage, 570
complete stricture of extrahepatic bile ducts; external hepaticostomy followed by spontaneous hepatoduodenal fistula, 18
gastric, effect of intravenously administered amino acids on stomach of woman with, 10
gastric, physiologic studies on stomach of woman with, 1
pancreatic; effect of exclusive parenteral feeding on closure of; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
pancreatic, surgical problem of periampullary cancer, 71
postoperative duodenal, present day treatment of, 637
Flashman, F. L.: Tumors of bone and of synovial membrane, 871
Flatfoot: See Foot, flat
Fluids; chemical studies on experimental hepatic congestion in dog, 24
chemistry; vomiting from duodenal, jejunal or upper ileal obstruction, 570
common solutions used to correct dehydration, 576
gastrointestinal loss, daily replacement of, 581
parenteral; amount needed for correction of dehydration, 573
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
potassium metabolism in immediate postoperative period, 470
Foot: See also Ankle; Astragalus; Calcaneum; Fingers and Toes; Metatarsus; etc.
Amputation: See Amputation
and ankle, conditions involving, 752
anomalies of, 752
deformities; arthrodesis, 758
deformities; arthrodesis of tarsal bones; study of failure of fusions, 162
deformities; roentgenologic changes in foot related to food deficiency, 752
disabilities of, 754

Foot—Continued
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
flat, in children, 756
flat, relationship between body weight and incidence of, 755
flat, spastic, 756
immersed, 761
infections of, 753
March: See Metatarsus
miscellaneous fractures and bone transplantation repair, 860
pain; metatarsalgia, 754
pain; Morton's metatarsalgia, 758
strain, 755
trench, 760
Foreign Bodies in knee joints, 666
Foss, E. L.: Tumors of bone and of synovial membrane, 871
Fractures: See also Ankle; Femur; Foot; Hip; Jaws; Pelvis; Scaphoid Bone, Carpal; etc.
and bony defects, operative procedures on, 866
deformities, 855
healing, changes in hydrogen ion concentration of, 863
march, 761
metabolism at different levels of protein intake, 864
phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
ununited, bone grafts for, 857
urinary excretion of calcium and phosphorus in patients convalescent from fracture, 865
Friedenberg, Z. B.: Arthrodesis of tarsal bones; study of failure of fusions, 162
Frostbite; value of transmetatarsal amputations in management of gangrene of toes, 497
Fuchs Test: See Cancer
Fungi: See also Actinomycosis; etc.
fungous infection of feet, 761
Furste, W.: Value of transmetatarsal amputations in management of gangrene of toes, 497

Gall Ducts: See Bile Ducts
Gallbladder: See Bile Ducts; Biliary Tract
Gangrene of toes, value of transmetatarsal amputations in management of, 497
Gastric Secretion: See under Stomach
Ulcer: See Peptic Ulcer
Gastritis: See Stomach, inflammation
Gastroduodenal Ulcer: See Peptic Ulcer
Gastrointestinal Tract: See also Colon; Intestines; Rectum; Stomach; etc.
anastomosis of ileum to lower part of rectum and anus; report on experiences with ileorectostomy and ileoproctostomy, with refereace to polyposis, 276
daily replacement of gastrointestinal fluid loss, 581
hemorrhage; multiple leiomyosarcomas of stomach; review of 16 cases and report of case, 62
Gastrojejunal Ulcer: See Peptic Ulcer
Gastrostomy: See under Stomach
Gauze: See Cellulose
Genitals: See also Genitourinary Tract; Urinary Tract; and under names of genitals, as Penis; etc.
anomalies, 727
external, wounds of, 927
Genitourinary Tract: See also Genitals; Urinary Tract; etc.
intravenous use of "pentothal sodium" anesthesia, 931
war injuries to, 927
George, E. M.: Phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
Ghormley, R. K.: Conditions involving knee joint, 743
Gibson, S.: Double aortic arch; report of 2 cases, 227
Glenn, F.: Clinic on disease of biliary tract, 686
Glomus Tumors: See Angioneuromyoma
Gold and Gold Compounds, Therapy: See Arthritis, therapy
Gonads: See Genitals; Hermaphroditism; Ovary; etc.
Gout, 731
Grafts: See Bones, transplantation; Surgery, plastic; etc.
Gragg, L.: Fat embolism, diagnostic enigma, 325
Graham, R. B.: Conditions involving knee joint, 743
Granuloma, eosinophilic, of bone, 890
Gray, H. K.: Carcinoma of pancreas, 763
Gray, J.: Evaluation of conservative resection with end to end anastomosis for carcinoma of rectum and lower sigmoid colon, 361
Grayzel, D.: Mixed tumor of bridge of nose, 148
Grindlay, J. H.: Resection of trachea; experimental study and report of case, 253
Growth, skeletal, vitamin A deficiency and excess in relation to, 862
Guiss, L. W.: Distribution of gastric changes accompanying gastric cancers in various locations, 624
Histologic basis for anacidity in gastric disease, 618
Gumma: See under Prostate
Gunshot Wounds: See Wounds
Gurdjian, E. S.: Modern surgical treatment of acute subdural abscess, 411
Gutierrez, R.: Review of urologic surgery, 699, 897
Gynecology; endometriosis in general abdominal surgery, 286
Gynecomastia: See Breast

Haight, C.: Surgical removal of unsuspected mediastinal lymphoblastomas; report of 4 cases and review of literature, 307
Hallux Rigidus: See Fingers and Toes
Hamby, W. B.: Trigeminal tractotomy; observations on 48 cases, 171
Hammer Finger: See Fingers and Toes, deformities
Hand: See also Fingers and Toes
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
Hand-Schüller-Christian Syndrome: See Schüller-Christian Syndrome
Hart, G. M.: Conditions involving knee joint, 743
Hashimoto's Disease: See under Thyroid
Hauser, E. D. W.: Conditions involving foot and ankle, 752
Head: See Cranium
Heart: See Blood, circulation; etc.
Heat: See Temperature
Heberden's Nodes: See Fingers and Toes, diseases
Hemangioma of spinal column, 879
Hemarthrosis: See Knee
Hematology: See Blood
Hematuria; malignant lesions of kidneys, 899
Hemoglobin and Hemoglobin Compounds: See Anemia; Blood; Hemolysis; etc.
Hemolysis; hemolytic reactions during transurethral prostatic resection, 919
Hemorrhage: See also Esophagus; Hemostasis; Intestines; etc.
blood determination and estimation of blood loss during surgical operations, 435
esophageal varices; 2 cases with different surgical approach, 391

Hemostasis; blood determination and estimation of blood loss during surgical operations, 435
harmful effects of oxidized cellulose gauze, 727
Hepatic Ducts: See Bile Ducts
Hepaticoduodenostomy: See under Bile Ducts
Hepler, A. B.: Review of urologic surgery, 699, 897
Heredity and arthritis, 733
Hermaphroditism, pseudo, 728
Hernia, femoral and inguinal hernioplasty; anatomic repair, 524
inguinal, incarcerated and strangulated; critical survey of 500 consecutive cases with treatment by nonsurgical (taxis) and surgical procedures, 267
potassium metabolism in immediate postoperative period, 470
tantalum gauze in repair of large postoperative ventral hernias, 234
Hernioplasty: See under Hernia
Herniorrhaphy: See under Hernia
Herrmann, L. G.: Value of transmetatarsal amputations in management of gangrene of toes, 497
Higinbotham, N. L.: Solitary (unicameral) bone cyst, 137
Hinman, F.: Review of urologic surgery, 699, 897
Hip: See also Femur
fractures, 855
reconstruction when loss of head and neck of femur has occurred, 857
Histamine injections; therapy in chronic arthritis, 739
Hodgkin's Disease; surgical removal of unsuspected mediastinal lymphoblastoma; report of 4 cases and review of literature, 307
Hoke Operation: See Foot, flat
Holden, W. D.: Aortic embolism, 613
Subphrenic abscess, 843
Sympathetic dystrophy, 373
Hooton, T. C.: Chemical studies on experimental hepatic congestion in dog, 24
Hormones, Androgenic: See Androgens
Estrogenic: See Estrogens
Humeroscapular Joint: See Shoulder
Humerus; solitary (unicameral) bone cyst, 137
Hunger; parenteral feeding of protein, 185
Hunt, C. J.: Early diagnosis and roentgen manifestations of obstruction of small bowel, 460
Hydrogen Ion Concentration of healing fractures, changes in, 863
Hydronephrosis, nephrectomy for, 906
obstructive jaundice caused by, 703
Hyperparathyroidism: See under Parathyroid
Hypertension: See Blood pressure, high
Hypertrophy: See under Prostate; Pylorus; Skin; etc.
Hypoglycemia: See Blood sugar
Hypoparathyroidism: See under Parathyroid
Hypospadias and epispadias, 728
Hypoxia: See Oxygen, deficiency

Icterus: See Jaundice
Ileostomy: See Anus, artificial; Colon
Ileum: See Intestines
Ilium; use of iliac bone in bone-grafting and arthrodesis, 859
Immersion Foot: See under Foot
Impotence following trauma to corpora cavernosa relieved by cartilage grafts, 924
Incontinence: See Urination
Infants: See also Children
double aortic arch; report of 2 cases, 227
embryoma of kidneys in, 897
osteofibrochondroma of scapula, 878
Infection: See also Wounds; etc.
focal, and chronic arthritis, 732
reevaluation of penicillin dosage schedules 396
Infection—Continued
role of antibiotics in masking inflammatory processes, 513
Inflammation: See Infection
Infusions: See Injections
Inguinal Canal: See Hernia, inguinal
Injections: See also Blood, transfusion
intravenous; effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
intravenous; effect of intravenously administered amino acids on stomach of woman with gastric fistula, 10
intravenous; parenteral feeding of protein, 185
Injuries: See under names of diseases, organs and regions, as Extremities; Knee; etc.
Instruments: See also Apparatus
early diagnosis and roentgen manifestations of obstruction of small bowel, 460
Intersexuality: See Hermaphroditism
Intestines: See also Colon; Duodenum; Gastrointestinal Tract; Rectum; Sigmoid; etc.
acute obstruction of colon with reference to factors of mortality, 774
anastomosis of ileum to lower part of rectum and anus; report on experiences with ileorectostomy and ileoproctostomy, with reference to polyposis, 276
hemorrhagic cyst of mesentery of ileum, 301
incarcerated and strangulated inguinal hernia; critical survey of 500 consecutive cases with treatment by nonsurgical (taxis) and surgical procedures, 267
obstruction; early diagnosis and roentgen manifestations of obstruction of small bowel, 460
preoperative place of streptomycin in operations on bowel, 520
regional enteritis; further pathologic observations, 195
Ulcers: See Peptic Ulcer
vomiting from duodenal, jejunal or upper ileal obstruction, 570
"Intocostrin": See Spasm
Iob, V.: Potassium metabolism in immediate postoperative period, 470
Irradiation: See Bladder
Isaacson, A. S.: Intraperitoneal rupture of urinary bladder complicating fracture of pelvis; technics of repair, 681
Islands of Langerhans: See Pancreas
Ivins, J. C.: Tumors of bone and of synovial membrane, 871

Jackson, R. G.: Anatomic study of vagus nerves with technic of transabdominal selective gastric vagus resection, 333
James, A. G.: Solitary (unicameral) bone cyst, 137
Janes, J. M.: Conditions involving knee joint, 743
Tumors of bone and of synovial membrane, 871
Jaundice; carcinoma of pancreas, 763
chronic pancreatitis causing complete and incomplete obstruction of common bile duct, 51
surgical problem of periampullary cancer, 71
Jaws; fibrous dysplasia of maxilla and mandible, 872
old fracture of mandible, 867
solitary cysts of mandible, 872
tumors; ameloblastoma, 894
tumors of mandible, 878
Jejunum: See Fistula; Intestines; Peptic Ulcer
Johnstone, G. A.: Thyroidectomy and parathyroids, 833

Joints: See also under names of individual joints, as Ankle; Hip; Knee; Wrist; etc.
bone transplantation in relation to nonunion of long bones, spine fusion and arthrodesis of peripheral joints, 858
deossifications regional to joints of extremities, 870
Inflammation: See Arthritis
Loose Bodies in: See Osteochondritis Dissecans; and under names of joints, as Knee; etc.

Keloid and hypertrophic scars, 539
Kershner, D.: Chemical studies on experimental hepatic congestion in dog, 24
Ketosis: See Diabetes Mellitus
Kidneys: See also Urinary Tract
abnormalities; renal displacement, 708
abnormalities; ureteral transplantation, 905
acidosis in acute and chronic nephritis, 571
anomaly, 699
artificial, 704
calculi, 906
calculi; high incidence of stones in kidneys and bladder in patients convalescing from skeletal injuries, 865
cancer; nephrectomy for malignant lesions of kidney, 900
cyst; renal enlargement simulating ovarian tumors, 707
Diseases: See also Hydronephrosis; Nephritis; Pyelonephritis
diseases; hypertension in cases of unilateral surgical disease of kidney, 903
diseases; lower nephron nephrosis, 705
embryoma of, 897
insufficiency, 704
insufficiency during and following severe dehydration, 580
ketosis of diabetic and nondiabetic origin, 571
lymphatic involvement in malignant lesions of, 901
malignant lesions of, 899
malignant neoplasms of, 701
obstruction; nephrectomy for hydronephrosis, 906
ruptured varix in ureteropelvic angle, 704
special solutions for severe alkalosis and acidosis, 578
tumors, benign, 699
tumors in children, 898
Wilm's tumor, 703
Knee: See also Patella; Semilunar Cartilages
anatomy and physiology, 743
arthritic degenerative, 659
arthrosis, after meniscectomy, 744
as focus of psychogenic symptoms, 651
conditions involving, 743
cysts of meniscuses, 658
injuries of, 657
internal derangements of, 745
lesions of patellar cartilage as cause of internal derangements of, 589
loose bodies in, 665
loose bodies of unknown origin, 660
method of fusion of joint, 751
pathologic conditions of, 743
pneumoroentgenography of, 748
postoperative hemarthrosis of, 660
surgical treatment of ruptured ligaments of, 668
traumatic osteoarthritic changes in, 671
use of iliac bone in bone-grafting and arthrodesis, 859
Köhler's Disease: See Metatarsus; Scaphoid Bone, Tarsal
König's Disease: See Osteochondritis Dissecans
Krukenberg Tumors: See Ovary, tumors
Kuhns, J. G.: Chronic arthritis, 729

Lacey, H. B.: Orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
Orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
Lam, C. R.: Tantalum gauze in repair of large postoperative ventral hernias, 234
Langerhans' Islands: See Pancreas
Laparotomy: See Abdomen, surgery
Legs: See also Extremities; Foot; and under names of bones and joints
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
Leiomyosarcoma of stomach; review of 16 cases and report of case of multiple leiomyosarcomas of stomach, 62
Lemmer, K. E.: Glomus tumors; summary of 15 cases, 531
Lenahan, N. E.: Blood determination and estimation of blood loss during surgical operations, 435
Letterer-Siwe Disease: See Reticuloendothelial System
Ligaments: See also Ankle; Knee; Wrist
anterior crucial, rupture of, 670
collateral, rupture of, 670
lesions of ligaments of knee, 749
of knee joint, 743
ruptured, of knee; surgical treatment, 668
Ligatures: See Sutures
Lindsay, D. T.: Conditions involving knee joint, 743
Lipogranulomatosis: See Xanthoma
Lipoma of extremities, 893
Lisfranc's Joint: See Metatarsus
Liver: See also Biliary Tract
actinomycosis of thorax and abdomen, 202
chemical studies on experimental hepatic congestion in dog, 24
Fistula: See Fistula
Luck, J. V.: Orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
Orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
Lungs: See also Thorax; etc.
carcinoma with intracranial metastasis; successful removal of metastasis and primary lesions, 849
cystic disease of, 427
Lye; physiologic studies on stomach of woman with gastric fistula, 1
Lymph Nodes: See also Lymphosarcoma; etc.
lymphatic spread of carcinoma of breast, 479
Lymphatic System: See also Lymph Nodes
lymphatic involvement in malignant lesions of kidneys, 901
Lymphoblastoma, mediastinal, unsuspected: surgical removal, 307
Lymphogranuloma, Hodgkin's: See Hodgkin's Disease
Lymphosarcoma; surgical removal of unsuspected mediastinal lymphoblastoma, 307

McCafferty, E. L.: Acute obstruction of colon with reference to factors of mortality, 774
McGrath, E. J.: Cystic disease of lung, 427
McGraw, A. B.: Testosterone propionate in treatment of recurrent cancer of breast, 385
McLaughlin, C. W., Jr.: Surgical management of branchiogenic cysts and sinus tracts, 450
Macrodactyly: See Fingers and Toes, abnormalities

McVay, C. B.: Inguinal and femoral hernioplasty; anatomic repair, 524
Maddock, W. G.: Parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
Madelung Deformity: See Wrist, deformity
Magnussen, M. J.: Cystic disease of lung, 427
Maier, H. C.: Dermoid cysts and teratomas of mediastinum with unusual features, 154
Malformations: See under names of organs and regions
Mammary Gland: See Breast
Mandible: See Jaws
Mapharsen: See Reiter's Disease
March Foot: See Foot
Fractures: See Fractures
Marvin, C. P.: Complete stricture of extrahepatic bile ducts; external hepaticostomy followed by spontaneous hepatoduodenal fistula, 18
Leiomyosarcoma of stomach; review of 16 cases and report of case of multiple leiomyosarcomas of stomach, 62
Maxillary Bone: See Jaws
Mederos, L. O.: Tumors of bone and of synovial membrane, 871
Mediastinum; dermoid cysts and teratomas with unusual features, 154
surgical removal of unsuspected mediastinal lymphoblastoma; report of 4 cases and review of literature, 307
Medicine, Military: See Military Medicine
Naval: See Naval Medicine
Mendenhall, J. T.: Role of antibiotics in masking inflammatory processes, 513
Meninges, abscess, subdural and acute; modern surgical treatment, 411
Meniscectomy: See under Semilunar Cartilages
Meniscus: See Semilunar Cartilages
Menopause, arthritis in, 731
Menstruation, disorders; endometriosis in general abdominal surgery, 286
Mesentery; hemorrhagic cyst of mesentery of ileum, 301
Metatarsalgia: See Foot, pain
Metatarsus: See also Foot
chondrosarcoma of first metatarsal bone, 877
Panner's syndrome, 761
value of transmetatarsal amputations in management of gangrene of toes, 497
Metcalf, D. W.: Blood determination and estimation of blood loss during surgical operations, 435
Meyerding, H. W.: Tumors of bone and of synovial membrane, 871
Michel, M. L.: Acute obstruction of colon with reference to factors of mortality, 774
Micturition: See Urination
Military Medicine: See also Aviation and Aviators; Naval Medicine; etc.
care of war casualties with defects in long bones, 859
foot problems in soldiers, 759
line of duty status of derangement of knee joint, 673
management of chronic arthritis among soldiers, 742
rehabilitation and evaluation of disability in orthopedic surgery, 868
wounds of external genitalia, 927
Miller, E. M.: Results of resection of vagus nerve for chronic peptic ulcer, 353
Miller-Abbott Tube: See Instruments
Mind; mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Mindlessness: See under Mind
Moersch, H. J.: Resection of trachea; experimental study and report of case, 253
Mohs, F. E.: Chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 813
Monroe, C. W.: Lymphatic spread of carcinoma of breast, 479
Morbidity: See Vital Statistics
Morton, H. S.: Preoperative place of streptomycin in operations on bowel, 520
Morton's Disease: See Foot, pain
Mucin: See Peptic Ulcer; Stomach, secretion
Mucous Membrane: See under Stomach
Muscles, Paralysis: See Paralysis
skeletal, rhabdomyosarcoma of, 895
Myeloma, multiple; treatment with 4,4'-diamidinostilbene ("stilbamidine"), 885
Myeloplaxoma: See Cells, tumor
Myxoma of lower extremity, 896

Narcosis: See Anesthesia
Nausea; vomiting from pyloric obstruction, 569
Naval Medicine: See also Aviation and Aviators; Military Medicine
urologic complications in injury of spinal cord, 912
Navicular Bones: See Scaphoid Bone, Carpal; Scaphoid Bone, Tarsal
Neck; surgical management of branchiogenic cysts and sinus tracts, 450
Neoplasms: See Cancer; Sarcoma; Tumors
Nephrectomy: See under Kidneys
Nephritis: See also Hematuria; Kidneys, diseases; Pyelonephritis; Uremia; etc.
acidosis in acute and chronic nephritis, 571
Nephrosis: See Kidneys, diseases
Nerves: See also Nervous System; Neuralgia; Paralysis
Blocking: See under Anesthesia
trigeminal tractotomy; observations on 48 cases, 171
vagus; anatomic study with technic of transabdominal selective gastric vagus resection, 333
vagus; results of resection for chronic peptic ulcer, 353
Nervous System: See also Brain; Nerves; Reflex; Spinal Cord; etc.
carcinoma of lung with intracranial metastasis; successful removal of metastasis and primary lesions, 849
glomus tumors; summary of 15 cases, 531
sympathetic dystrophy, 373
tumors; glomus tumors (angioneuromyomas), 895
Neuralgia; trigeminal tractotomy; observations on 48 cases, 171
Neurectomy: See Nerves, vagus
Neurofibromatosis, multiple, and skeletal changes, 892
Neuroses and Psychoneuroses; knee joint as focus of psychogenic symptoms, 651
psychologic problems observed in treatment of dislocations of shoulder, 809
Nicola Operation: See under Shoulder
Nipple: See Breast
Nitrogen in Urine: See Urine, nitrogen
Nomenclature; camptodactyly, 633
classification of vascular neoplasm of bone, 881
giant cell lesions of bone, 877
lesions of patellar cartilage as cause of internal derangements of knee, 589
Nose, mixed tumor of bridge of, 148
Nutrition: See also Dystrophy; Vitamins
disorders; parenteral feeding of protein, 185
need for vitamins by surgical patients, 585
parenteral, fat emulsions for, 584
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
roentgenologic changes in foot related to food deficiency, 752
vitamin A deficiency and excess in relation to skeletal growth, 862

Oberheiman, H. A.: Hemorrhagic cyst of mesentery of ileum, 301
O'Conor, V. J.: Review of urologic surgery, 699, 897
Oddi's Sphincter: See Sphincter Muscles
Olecranon: See Ulna
Oliguria: See Urine, suppression
Olwin, J. H.: Results of resection of vagus nerve for chronic peptic ulcer, 353
Orthopedics: See also Amputation; Bones; Fractures; etc.
apparatus and arthritis, 741
everyday orthopedics, 754
orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
progress in orthopedic surgery for 1946; review prepared by Editorial Board of American Academy of Orthopaedic Surgeons, 729, 855
rehabilitation and evaluation of disability in orthopedic surgery, 868
Os Acromiale: See Scapula
Calcis: See Calcaneum
Centrale: See Wrist
Ossification: See Bones, growth; Knee
Osteoarthritis; traumatic changes in knee, 671
Osteochondritis Dissecans, 659, 744
femoral condyles and patella, 665
lesions of patellar cartilage as cause of internal derangements of knee, 589
Osteochondroma of pelvis, 877
Osteoclasis: See Bones, surgery
Osteofibrochondroma of scapula, 878
Osteogenesis: See Bones, growth
Osteoma, osteoid, 872
Osteoporosis: See Bones, atrophy
Osteotomy: See Femur, surgery
Ovary, tumor, renal enlargement simulating, 707
Owens, F. M., Jr.: Regional enteritis; further pathologic observations, 195
Oxophenarsine Hydrochloride: See Reiter's Disease
Oxycel: See Cellulose
Oxygen, deficiency; mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
in pneumoroentgenography of knee joints, 748

Pack, G. T.: Surgical problem of periampullary cancer, 71
Pain: See under Extremities
Palsy: See Paralysis
Pancreas, carcinoma of, 763
chronic pancreatitis causing complete and incomplete obstruction of common bile duct, 51
effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
Fistula: See Fistula
surgical problem of periampullary cancer, 71
Pancreaticojejunostomy: See Fistula, pancreatic
Pancreatitis, chronic, causing complete and incomplete obstruction of common bile duct, 51
Pangastritis: See Stomach, inflammation
Panner's Syndrome: See Metatarsus
Papilla of Vater: See Vater's Ampulla
Paralysis, generalized spastic, and mindlessness following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Paralysis—Continued
spinal; treatment of paraplegic, 914
spinal; vesical calculi among paraplegic patients, 908
Paraplegia: See Paralysis, spinal
Parathyroid and thyroidectomy, 833
Paschall, J., Jr.: Conditions involving knee joint, 743
Patella, 747. See also Knee
and femur, trauma to articular surfaces of, 666
cartilage; lesions as cause of internal derangements of knee, 589
chondromalacia of, 659, 671
osteochondritis dissecans of femoral condyles and patella, 665
Patella Cubiti: See Elbow
Peabody, C. W.: Lesions of patellar cartilage as cause of internal derangements of knee, 589
Pellegrini-Stieda's Disease: See Femur
Pelvis: See also Genitals; Genitourinary Tract; etc.
actinomycosis of thorax and abdomen, 202
endometriosis in general abdominal surgery, 286
intraperitoneal rupture of urinary bladder complicating fracture of; technics of repair, 681
irradiation reactions in bladder after roentgen and radium treatment of female pelvic disease, 908
osteochondroma of, 877
Penicillin, reevaluation of dosage schedules, 396
Therapy: See Abscess, subphrenic; Actinomycosis; Meninges, abscess; Urinary Tract; etc.
Penis; impotence following trauma to corpora cavernosa relieved by cartilage grafts, 924
malignant neoplasm, 923
Peyronie's disease, 924
Pentothal Sodium: See Anesthesia
Peptic Ulcer; anatomic study of vagus nerves with technic of transabdominal selective gastric vagus resection, 333
chronic, results of resection of vagus nerve for, 353
distribution of gastric changes accompanying gastric cancers in various locations, 624
gastric resection for duodenal ulcer, 697
histologic basis for anacidity in gastric disease, 618
vomiting from pyloric obstruction, 569
Perinephritis; perinephric abscess, 708
Peristalsis: See Intestines, obstruction
Peritonitis: See also Appendicitis
role of antibiotics in masking inflammatory processes, 513
Peterson, L. T.: Hip fractures, 855
Peyronie's Disease: See under Penis
Phalanges: See Fingers and Toes
Pharynx; surgical management of branchiogenic cysts and sinus tracts, 450
Phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
Phosphorus and Phosphorus Compounds; calcium and phosphorus in urine in patients confined to bed with casts, 865
Phthalylsulfathiazole: See Urinary Tract
Pils, A. R. W.: Conditions involving knee joint, 743
Tumors of bone and of synovial membrane, 871
Plasma: See under Blood
Plaster of Paris: See Casts
Plastic Surgery: See Surgery, plastic
Pneumonectomy: See Lungs
Pneumoroentgenography: See Knee
Poisons and Poisoning: See also under names of poisonous substances
chloro-ortho-toluidine as toxic analine dye, 714

Polyarthritis: See Arthritis
Polyposis: See Colon
Polythene Tube; resection of trachea; experimental study and report of case, 252
Poncet's Disease: See Arthritis
Portal Vein; chemical studies on experimental hepatic congestion in dog, 24
esophageal varices; 2 cases with different surgical approach, 391
Potassium, 582
metabolism in immediate postoperative period, 470
Potts, W. J.: Double aortic arch; report of 2 cases, 227
Prepuce: See Penis
Prostate, adenoma, endourethral resections for, 918
cancer; reactions in mammary glands in treatment with estrogen, 922
carcinoma of, 719, 920, 921
fibromyoadenoma of periurethral glands, 921
hemolytic reactions during transurethral prostatic resection, 919
hypertrophy of, 715
oliguria following post-transurethral resection syndrome, 920
retropubic prostatectomy, 916
surgical procedures, 915
syphilitic gumma of, 724
Prostatectomy: See under Prostate
Proteins: See also Amino Acids; Nitrogen; etc.
effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
intake, fracture metabolism at different levels of, 864
parenteral feeding of, 185
Pseudoarthrosis in children, 857
Pseudohermaphroditism: See Hermaphroditism
Psychoses: See Neuroses and Psychoneuroses
Public Health; arthritis as social and industrial problem, 742
Pulse: See Blood pressure
Puppendahl, M.: Tantalum gauze in repair of large postoperative ventral hernias, 234
Pyelography: See also Hydronephrosis; Kidneys
malignant lesions of kidneys, 899
urography, 928
Pyelonephritis; hypertension and renal disease, 707
Pylorus, obstruction, relaxation of gastric mucosa producing, 45
obstruction, vomiting from, 569

Rabinovitch, J.: Mixed tumor of bridge of nose, 148
Radiations: See Roentgen Rays
Radioulnar Joint: See Wrist
Radius; viability of cancellous bone, 860
Ratliff, R. K.: Intraperitoneal rupture of urinary bladder complicating fracture of pelvis; technics of repair, 681
von Recklinghausen's Disease: See Neurofibromatosis
Recruits: See Military Medicine
Rectum; anastomosis of ileum to lower part of rectum and anus; report on experiences with ileorectostomy and ileoproctostomy, with reference to polyposis, 276
evaluation of conservative resection with end to end anastomosis for carcinoma of rectum and lower sigmoid colon, 361
experiences with Dragstedt skin-covered ileostomy, 487
surgical anatomy of anal canal, 791
Reflex or automatic type of bladder, 913
Rehabilitation and evaluation of disability in orthopedic surgery, 868
Reiter's Disease, 728, 731
oxophenarsine hydrochloride (mapharsen) in treatment of, 728
Rékai, J.: Present day treatment of postoperative duodenal fistula, 637
Requarth, W.: Incarcerated and strangulated inguinal hernia; critical survey of 500 consecutive cases with treatment by nonsurgical (taxis) and surgical procedures, 267
Reticuloendothelial System; relationship of eosinophilic granuloma of bone to Letterer-Siwe and Hand-Schüller-Christian disease, 890
Rhabdomyosarcoma of skeletal muscles, 895
Rheumatism: See also Arthritis; Osteoarthritis
tuberculous, problem of, 729
Ribs, chondroma of, 879
Riedel's Struma: See Thyroid
Roentgen Rays, Therapy: See under Arthritis; Lymphoblastoma; Penis; Sarcoma; Thyroid; etc.
Ross, C. A.: Effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
Rothwell, R.: Double aortic arch; report of 2 cases, 227

Sachs, J.: Patella cubiti; new method of treatment for its avulsion, 675
Sacroiliac Joint, ankylosis of, 735
Sanders, G. B.: Experiences with Dragstedt skin-covered ileostomy, 487
Sarcoma: See also Cancer; Chondrosarcoma; Leiomyosarcoma; Lymphosarcoma; Rhabdomyosarcoma; Tumors; and under names of organs and regions; etc.
Ewing's, of bone, 879
of bone treated by radiotherapy, 884
osteogenic sarcoma, 881
Sarver, F. E.: Mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Scandalis, R.: Conditions involving knee joint, 743
Scaphoid Bone, Carpal; end results of excision, 245
orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
radiocarpal arthrodesis, 815
Scaphoid Bone, Tarsal; arthrodesis of tarsal bones; study of failure of fusions, 162
Scapula, osteofibrochondroma of, 878
Scars: See Cicatrix
Schafer, P. W.: Camptodactyly, 633
Schaff, B.: Camptodactyly, 633
Schmidt, E. R.: Role of antibiotics in masking inflammatory processes, 513
Scholl, A. J.: Review of urologic surgery, 699, 897
Schüller-Christian Syndrome; relationship of eosinophilic granuloma of bone to Letterer-Siwe and Hand-Schüller-Christian disease, 890
Sclerosis: See Arteriosclerosis
Semilunar Cartilages; arthrosis of knee after meniscectomy, 744
complications following meniscectomy, 660
internal derangements of knee, 645, 745
lesions of meniscuses, 656
Seminal Vesicles, calcification of, 930
Serum: See Blood
Sesamoid Bone: See Fingers and Toes
Sex, Intergrades: See Hermaphroditism
Shands, A. R., Jr.: Orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
Orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801

Shea, P. C., Jr.: Subphrenic abscess, 843
Shinners, B. M.: Trigeminal tractotomy; observations on 48 cases, 171
Shock; blood determination and estimation of blood loss during surgical operations, 435
fluid and nutritional therapy of burns, 573
intraperitoneal rupture of urinary bladder complicating fracture of pelvis; technics of repair, 681
Shoulder: See also Humerus; Scapula
chemosurgical treatment of cancer of extremities and trunk; microscopically controlled method of excision, 818
dislocation, evaluation of operative technics in treatment of, 806
dislocation, recurrent, 801
Sigmoid: See also Colon; Intestines
evaluation of conservative resection with end to end anastomosis for carcinoma of rectum and lower sigmoid colon, 361
Sinus; surgical management of branchiogenic cysts and sinus tracts, 450
Skeleton: See Bones
Skin; keloids and hypertrophic scars, 539
Skull: See Cranium
Smathers, H. M.: Treatment of tetanus, 291
Smith, F.: Preoperative place of streptomycin in operations on bowel, 520
Smith, H. M. A.: Orthopedic surgery in Army Air Forces during World War II; introduction and internal derangements of knee, 642
Orthopedic surgery in Army Air Forces during World War II; recurrent dislocation of shoulder and ununited fractures of carpal scaphoid, 801
Sodium Citrate: See Blood, transfusion
Soldiers: See Military Medicine
Spasm; treatment of tetanus, 291
Sphincter Muscles; surgical anatomy of anal canal, 791
Spinal Cord: See also Meninges; Nervous System; etc.
cord bladder, 913
injuries, urologic complications in, 912
Spine: See also Sacroiliac Joint
bone transplantation in relation to nonunion of long bones, spine fusion and arthrodesis of peripheral joints, 858
hemangioma of spinal column, 879
rheumatoid spondylitis, 733
Spitz, T. A.: Blood determination and estimation of blood loss during surgical operations, 435
Spondylitis: See Spine
Sprue; thrush infection, 714
Stack, J. K.: End results of excision of carpal bones, 245
Stewart, F. W.: Distribution of gastric changes accompanying gastric cancers in various locations, 624
Histologic basis for anacidity in gastric disease, 618
Stieda-Pellegrini's Disease: See under Femur
Stilbamidine: See Bones, tumors
Stilbestrol: See Estrogens
Still's Disease: See Arthritis, rheumatoid
Stomach: See also Gastrointestinal Tract; Pylorus
acidity in gastric disease; histologic basis, 618
anatomic study of vagus nerves with technic of transabdominal selective gastric vagus resection, 333
cancer; distribution of gastric changes accompanying gastric cancers in various locations, 624
diseases, histologic basis for anacidity in, 618
effect of intravenously administered amino acids on stomach of woman with gastric fistula, 10
Fistula: See Fistula, gastric
Stomach—Continued
inflammation; distribution of gastric changes accompanying gastric cancers in various locations, 624
leiomyosarcoma; review of 16 cases and report of case of multiple leiomyosarcomas of stomach, 62
physiologic studies of woman with gastric fistula, 1
relaxation of gastric mucosa producing pyloric obstruction, 45
resection for duodenal ulcer, 697
resection; present day treatment of postoperative duodenal fistula, 637
secretions; vomiting from duodenal, jejunal or upper ileal obstruction, 570
Ulcers: See Peptic Ulcer
vomiting from pyloric obstruction, 569
Stone: See Bladder, calculi; Kidneys, calculi; etc.
Streblomicrodactyly: See Fingers and Toes, deformities
Streptomycin, preoperative place in operations on bowel, 520
Therapy: See Urinary Tract, infections
Stricture: See Bile Ducts
Strohl, E. L.: Mindlessness and generalized spastic paralysis following cyclopropane anesthesia; sequelae in child with acute appendicitis, 405
Struma Lymphomatosa: See Thyroid
Sudeck's Disease: See Bones, atrophy
Sulfonamides, preoperative place in operations on bowel, 520
Therapy: See Actinomycosis; Urinary Tract; etc.
Suprarenals: See Adrenals
Surgery: See also Apparatus; Instruments; Sutures; Wounds; etc.
blood determination and estimation of blood loss during, 435
Orthopedic: See Orthopedics
plastic; impotence following trauma to corpora cavernosa relieved by cartilage grafts, 924
plastic; keloids and hypertrophic scars, 539
plastic; old fracture of mandible, 867
potassium metabolism in immediate postoperative period, 470
Surgical Clinics:
Clinic on disease of biliary tract, 686
Sutures; prevention and treatment of wound dehiscence, 217
Sympathectomy; sympathetic dystrophy, 373
Synovial Fluid, increased, in knee joint, 648
Synovial Membrane and bone, tumors of, 871
pathologic conditions of knee joint, 743
Syphilis: See under diseases, organs and regions, as Prostate; etc.
Szilagyi, D. E.: Tantalum gauze in repair of large postoperative ventral hernias, 234

Talocalcanean Joint: See Ankle
Talus: See Astragalus
Tantalum gauze in repair of large postoperative ventral hernias, 234
Tarsus: See also Ankle; Astragalus; Calcaneum; Foot; Scaphoid Bone, Tarsal
arthrodesis of; study of failure of fusions, 162
Taylor, E. R.: Gastric resection for duodenal ulcer, 697
Temperature, body, and arthritis, 735
Temporomandibular Joint: See Jaws
Teratoma and dermoid cysts of mediastinum with unusual features, 154
Testosterone Propionate: See Androgens
Tetanus, treatment, 291
Theis, F. V.: Incarcerated and strangulated inguinal hernia; critical survey of 500 consecutive cases with treatment by nonsurgical (taxis) and surgical procedures, 267

Thigh: See also Hip; Legs
right, chondromyxosarcoma of, 878
Thomas, P. O.: Effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
Thompson, G. J.: Review of urologic surgery, 699, 897
Thorax: See also Lungs; Mediastinum; Ribs; etc.
and abdomen, actinomycosis of, 202
Thrombosis; aortic embolism, 613
fat embolism; diagnostic enigma, 325
Thrush: See Sprue
Thumb: See Fingers and Toes
Thyroid; thyroidectomy and parathyroids, 833
treatment of thyroiditis, 443
Thyroidectomy: See under Thyroid
Thyroiditis: See under Thyroid
Thyrotoxicosis: See Thyroid
Tibia; bone transplantation in relation to nonunion of long bones, spine fusion and arthrodesis of peripheral joints, 858
care of war casualties with defects in long bones, 859
tubercle of, 750
Tibiotarsal Joint: See Ankle
Tic Douloureux: See Neuralgia, trigeminal
Tissue: See also Cells
phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
tantalum gauze in repair of large postoperative ventral hernias, 234
Toes: See Fingers and Toes
Trachea; double aortic arch, 227
resection; experimental study and report of case, 253
Tractotomy: See Nerves, trigeminal
Transfusion: See Blood, transfusion
Transplantation: See Bones; Ureters; etc.
Trauma: See also Brain; Diabetes Mellitus; Neuroses and Psychoneuroses; Shock; Tumors; etc.
fat embolism; diagnostic enigma, 325
phosphatase activity in blood serum, bone and soft tissues following fracture in cat, 113
to articular surfaces of femur and patella, 666
to corpora cavernosa; impotence following, relieved by cartilage grafts, 924
traumatic osteoarthritic changes in knee, 671
Tremor of ipsilateral lower extremity with anxiety state, 751
Trochanter: See Femur
Trochlea: See Humerus
Trusler, H. M.: Keloids and hypertrophic scars, 539
Tuberculosis: See also under names of diseases, organs and regions
and rheumatism, problems of, 729
Tuberosity: See under Tibia
Tubocurarine: See Spasm
Tumors: See also Adenoma; Angioma; Angioneuromyoma; Cancer; Chondroma; Embryoma; Endothelioma; Fibromyoadenoma; Granuloma; Hemangioma; Lipoma; Lymphoblastoma; Myeloma; Myxoma; Osteochondroma; Osteofibrochondroma; Osteoma; Sarcoma; Teratoma; Xanthoma; and under names of organs and regions, as Adrenals; Bones; Femur; Jaws; Kidneys; Knee; Mediastinum; Meninges; Nose; Pelvis; Patella; Prostate; Radius; Ribs; Spine; Thyroid; Trachea; etc.
dermoid cysts and teratomas of mediastinum with unusual features, 154
mixed, of bridge of nose, 148

Ulcers, Peptic: See Peptic Ulcer
Varicose: See Varicose Veins
Ulna; care of war casualties with defects in long bones, 859
patella cubiti; new method of treatment for its avulsion, 675
Uremia: See also Nephritis
chronic, treatment of, 704
Ureters: See also Urinary Tract
empyema, 711
fistula, 711
transplantation, 710, 905
Urethra, control of incontinence in male by "artificial sphincter," 927
Inflammation: See Reiter's Disease
malignant neoplasms, 925
Urethritis: See Reiter's Disease
Urinary Tract: See also Genitals; Genitourinary Tract; Kidneys; Ureters; etc.
anomaly, 710
antisepsis, 724
infections, 931
infections; phthalylsulfathiazole in treatment, 724
infections, treated with streptomycin, 929
Urination, disorders; anuria following blood transfusion, 928
disorders; renal insufficiency during and following severe dehydration, 580
incontinence, aponeurotic suspension in treatment of, 909
incontinence; control in male by "artificial sphincter," 927
incontinence; problem of stress incontinence, 911
transurethral resection, 914
Urine: See also Hematuria; Urination; etc.
acidosis in acute and chronic nephritis, 571
nitrogen; fracture metabolism at different levels of protein intake, 864
potassium metabolism in immediate postoperative period, 470
suppression; oliguria following post-transurethral resection syndrome, 920
suppression, prerenal influence precipitating, 704
suppression; renal insufficiency during and following severe dehydration, 580
urinary excretion of calcium and phosphorus in patients convalescent from fracture, 865
Urography: See Pyelography
Urologic Surgery, review of, 699, 897
Uterus: See Pelvis

Vagotomy: See Nerves, vagus
Vagus Nerve: See Nerves, vagus
Varicose Veins: See also Esophagus, varix
ruptured varix in ureteropelvic angle, 704
Varix: See Varicose Veins
Vas Deferens, calcification of, 930
Vasomotor System: See Arteries; Blood pressure; Blood vessels; Capillaries; etc.
Vater's Ampulla; effect of exclusive parenteral feeding on closure of pancreatic fistula; study made after duodenopancreatic resection for carcinoma of ampulla of Vater, 104
surgical problem of periampullary cancer, 71
Veins: See Blood vessels; Embolism; Thrombosis; etc.
Portal: See Portal Vein
Varicose: See Varicose Veins
Venae Cavae; chemical studies on experimental hepatic congestion in dog, 24
Venous Pressure: See Blood pressure
Vertebrae: See Spine
Verumontanum: See Urethra
Viscera: See also Abdomen; Pelvis; Reflex; Thorax; etc.
actinomycosis of thorax and abdomen, 202
Vital Statistics; acute obstruction of colon with reference to factors of mortality, 774

Vitamins, A deficiency and excess in relation to skeletal growth, 862
D; high incidence of stones in kidneys and bladder in patients convalescing from skeletal injuries, 865
in treatment of chronic arthritis, 738
need by surgical patients, 585
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
Volvulus: See Colon
Vomiting from duodenal, jejunal or upper ileal obstruction, 570
from pyloric obstruction, 569
Voth-Ostendorph, F.: Thyroidectomy and parathyroids, 833

Walker, S. M.: Effect of intravenously administered amino acids on stomach of woman with gastric fistula, 10
Physiologic studies on stomach of woman with gastric fistula, 1
Walsh, F. P.: Lesions of patellar cartilage as cause of internal derangements of knee, 589
Walters, W.: Complete stricture of extrahepatic bile ducts; external hepaticostomy followed by spontaneous hepatoduodenal fistula, 18
Gastric resection for duodenal ulcer, 697
Leiomyosarcoma of stomach; review of 16 cases and report of case of multiple leiomyosarcomas of stomach, 62
Walton, F. E.: Prevention and treatment of wound dehiscence, 217
War: See also Aviation and Aviators; Military Medicine; Naval Medicine; etc.
care of casualties with defects in long bones, 859
injuries to genitourinary tract, 927
Water: See also Fluids
and electrolytes in surgical patients, 568
estimation of daily requirements, 556
kind of fluid for daily requirements, 559
parenteral use of water, dextrose, electrolytes, fat and vitamins, 553
Webster, J. E.: Modern surgical treatment of acute subdural abscess, 411
Weed, M. R.: Treatment of tetanus, 291
Wilm's Tumor: See under Kidneys
Wounds: See also Military Medicine; Naval Medicine; War
prevention and treatment of dehiscence, 217
war injuries to genitourinary tract, 927
Wrist: See also Scaphoid Bone, Carpal; Semilunar Bone
end results of excision of carpal bones, 245
use of iliac bone in bone-grafting and arthrodesis, 859

Xanthoma in knee, 896
X-Rays: See Roentgen Rays

Zacho, A.: Relaxation of gastric mucosa producing pyloric obstruction, 45

MEDICAL LIBRARY

FEB 25 1949

VOLUME 57 NUMBER 6

ARCHIVES OF SURGERY

EDITORIAL BOARD

WALTMAN WALTERS, Chairman, Rochester, Minn.

LESTER R. DRAGSTEDT, Chicago

ROBERT ELMAN, St. Louis

ALTON OCHSNER, New Orleans

ARTHUR W. ALLEN, Boston

ALFRED BLALOCK, Baltimore

A. J. SCHOLL, Los Angeles

G. E. LINDSKOG, New Haven, Conn.

COBB PILCHER, Nashville, Tenn.

DECEMBER 1948

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO 10, ILLINOIS. ANNUAL SUBSCRIPTION, $10.00

Entered as Second Class Matter July 10, 1925, at the Postoffice at Chicago, Under the Act of Congress of March 3, 1879

COPYRIGHT, 1949, BY THE AMERICAN MEDICAL ASSOCIATION